Modelling governance and institutions for global sustainability politics (ModelGIGS). Theoretical foundations and conceptual framework

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Modelling Governance and Institutions for Global Sustainability Politics (ModelGIGS)

Theoretical Foundations and Conceptual Framework

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Summary

This report presents the conceptual and theoretical foundations of the ModelGIGS project that aims at integrating scientific knowledge on governance and institutions into formal integrated assessment and modelling approaches.

The more quantitatively oriented modelling and scenarios community is increasingly interested in international regimes, which play a central role in global environmental governance. As a result of the increasing interdependence and interconnectedness in world politics, states are largely unable to isolate themselves from outside events. Consequently, there is an increase in collective action problems related to international public goods, commons and shared natural resources. Thus, since the 1972 United Nations Conference on the Human Environment, international environmental regimes have proliferated, a development that has been even more pronounced since the 1992 UN Conference on Environment and Development in Rio de Janeiro. Today, more than 200 multilateral treaties regulate environmental problems ranging from the overexploitation of natural resources to problems of global environmental change, such as climate change or biodiversity loss.

A number of approaches exist toward understanding and measuring the effectiveness of institutions in steering society and the international system at large towards sustainability in the fields of International Relations and global environmental governance research. Within this research field, the literature on international regimes provides numerous hypotheses regarding the factors that increase or diminish the likelihood of regime formation and implementation. The ModelGIGS project has synthesized this research into a number of concrete rules that describe the likelihood of regime formation and implementation with a view towards integrating these findings into more formalized methodologies such as modelling, computer simulation and scenario development.

This report includes two main parts. The first part (chapter 2) provides a brief literature review that introduces the field of research and the general theoretical debate about international regimes within the disciplinary field of International Relations and institutional theory. More specifically, the literature review introduces the key concepts and various approaches to understanding regime formation, regime implementation and effectiveness.

As global environmental problems have particular attributes that distinguish them from other policy problems, international environmental regimes share particular characteristics that distinguish them from approaches in other areas. Among these commonalities are for example the fact that many environmental resources are ‘public goods’, which are likely to cause collective-action problems; that they are usually transboundary and thus require action from the international community; and that environmental issues are often characterized by high uncertainty, complexity, long-term impacts, and a need for decisive regulatory intervention. These characteristics indicate that regimes can be necessary to address the transboundary, collective-action nature of environmental problems, yet agreeing on and implementing successful regimes among more than 190 states can be costly and difficult. Nonetheless, particular factors may make regime formation more (or less) likely, and similarly, specific factors may make regime implementation more (or less) likely.

This report understands the evolution and operation of international environmental regimes as a long-term process, which is affected by various characteristics over time. Consequently, we distinguish between regime formation and regime implementation.

Within regime formation, first and foremost, the attributes of the environmental problem – here labelled problem structure – are influential. Each environmental problem has distinguishing features that define its degree of complexity and salience, and consequently, different problem types call for different solutions. Based on the existing literature on international regimes, our conceptual model concentrates on several characteristics of problem structure that influence regime formation and implementation. The problem characteristics that are distinguished are collaboration problems, coordination problems, systemic environmental problems, cumulative environmental problems, regulation costs, public concern and extent of scientific uncertainty. These problem characteristics may influence the likelihood of regime formation and implementation due to issues such as the distribution of costs and benefits of a problem and its potential solutions (for example, during transboundary pollution, the polluting country only pays a part of the costs, but enjoys all the benefits of the polluting activity).

Second, specific characteristics affect the context of actual international negotiation at conferences – we refer to this as the negotiation process. The negotiation process through which states agree on international cooperation is affected by the negotiation costs, whether and to what degree differentiation of rules occurs, the availability of side-payments during the negotiations, and whether the issues to be negotiated create cumulative or cross-cutting cleavages. For example, differentiation of rules may have a positive influence on regime formation and implementation, as it is especially common that the various actors are responsible for the environmental problem to different extents, which do not necessarily match the extent to which these actors suffer from the environmental damage caused. Rule differentiation allows sensitivity to such differing levels of responsibility.

Third, the negotiation process affects and is affected by the constraints and autonomy of the negotiating countries and the ultimate targets (e.g. companies) of the envisaged regulations – labelled actors. The actor-related issues in the regime literature examined in this report include interest asymmetry, powerful states, homogeneity of actors (as a determinant of conflicting or overlapping state interests), and number of economic sectors. All these issues may affect regime formation and/or implementation. For example, if the interests of states regarding a particular problem diverge (and they are therefore asymmetric), reaching a common agreement is more difficult.

Fourth, regime negotiation and implementation does not occur in a vacuum: other institutions, organizations or norms in the wider international system influence both the negotiation and the actors' preferences - labelled regime environment. Among the ones discussed in this report and included in the conceptual framework are institutional interplay (referring to potential interactions and conflict with other regimes) and participation referring to the increasingly recognized importance of active participation by the stakeholders that are the targets of regulation, which is often argued to increase the effectiveness of the implementation process).

These four building-blocs represent the variables for regime formation. If the conditions in each area are favourable, the likelihood of regime formation increases. During the regime implementation stage, problem structure, actors and regime environment will still influence the success of regime implementation. The negotiation phase, however, is no longer important. Instead, as a fifth and final category, the success of implementation also depends on different choices and components of the institutional structure – labelled regime design. Thus, a section of the literature review is dedicated to aspects of regime design, including scientific knowledge generation,

programmatic activities, decision rules, compliance and compliance mechanisms, positive incentives and sanctions, verification/monitoring mechanisms, systems for implementation review, regime secretariats, and autonomous standing decision-bodies. Decision rules and procedures, for example, are often considered relevant for regime implementation as an important determinant of institutional capacity to combine interests and preferences of actors into cooperative results, with empirical evidence suggesting that consensual rules are more likely to increase goal attainment, and to a lesser extent even problem solving, than unanimity.

The second part of the report (chapter 3) presents the conceptual framework for analyzing regime formation and implementation with a view towards integrating this body of knowledge into more formal approaches such as modelling and scenario development. Based on the theoretical findings of regime literature outlined above, 60 rules are derived that describe regime formation and regime implementation (i.e. effectiveness) under certain conditions. In devising these rules, a number of decisions have been taken by the research team that need justification: First, the development of the rules from the regime literature it is based on expert judgments, but can of course be contested. Second, it is important to note that the literature surveyed for this report is not a completely coherent body of literature in itself. Rather, it incorporates a wide range of underlying purposes and diverging concepts, which in turn necessitates interpretation. Third, not all relevant literatures on cooperation between states (such as game theory) could be included. Fourth, in formulating the rules, we also had to accommodate specific requirements stemming from our aim to fit institutional theory into a computer model. Fifth, in the rules identified in the previous section, we include only statements derived from our review of regime literature. Thus, even if the inverse statement of a rule seems plausible as well, it is only included here if the observation is supported by our review of regime literature.

Chapter 3 consequently introduces the key concepts underlying these generic rules. Each key concept can be understood as a variable in the conceptual framework. This conceptual model will be turned into a computer model to systematically analyze regime formation and implementation. Furthermore, in order to test this computer model on real life cases, each variable was operationalised, either in a qualitative manner or in terms of (quantitative) indicators. The section on regime formation introduces the detailed on problem structure, negotiation process, actors, and regime environment, while the section on regime implementation examines how different aspects of problem structure, actors, regime environment and regime design influence the implementation of the regime. A full list of rules and a glossary of the key terms used in this study are given in annexes A and B.

1 Introduction

This report presents the conceptual and theoretical foundations of the ModelGIGS project, which aims at integrating scientific knowledge on governance and institutions into formal modelling approaches. To this end, the report summarizes a conceptual model for analyzing the formation and implementation of international environmental regimes.[1]

Governance and institutions are increasingly becoming a central concern within the more quantitatively oriented modelling and scenarios community (see Biermann et al. 2007; Biermann and Pattberg 2008). Within the fields of International Relations and global environmental governance research, a number of approaches have emerged that attempt to understand (measuring) the effectiveness of institutions in steering society and the international system at large towards sustainability (Bernauer 1995; Breitmeier et al. 2006; Sprinz and Helm 1999). Thus, the literature on international regimes provides numerous hypotheses regarding the factors that increase or diminish the likelihood of successful regime formation and implementation.

The ModelGIGS project aims at synthesizing and integrating the findings of this research program into more formalized integrated assessment methodologies, such as modelling, computer simulation and scenario development, making it a cutting-edge research approach in the field of sustainability science. Thus, this project aims to not only analyze what factors make existing regimes more likely to emerge and be effective, but also to gain insight in the feasibility of regime formation and implementation in other areas where international cooperation is thus far limited or absent.

This report includes two main parts. The first part (chapter 2) provides a brief literature review that introduces the field of research and the general theoretical debate about international regimes within the disciplinary field of International Relations. More specifically, the literature review introduces the key concepts and various approaches to understanding regime formation, regime implementation and effectiveness, including a discussion of the fundamental intervening factors.

The second part presents the conceptual framework for analyzing regime formation and implementation (chapter 3). Based on the theoretical findings of regime literature, 52 ‘rules’ have been developed that describe regime formation and regime implementation under certain conditions (see Annex A for the full list of rules). Chapter 3 consequently introduces the key concepts underlying the generic rules. Each key concept can be understood as a variable in the overall conceptual framework. This conceptual model will also be turned into a computer model to systematically analyze regime formation and implementation. Furthermore, in order to test this computer model on real life cases, each variable has been carefully operationalised, either in a qualitative manner or in terms of (quantitative) indicators.

1 The report provides background information on the scientific findings of regime theory and the subsequent ‘rules’ that have been formulated for inclusion in a computer-based model (cf. de Vos et al. 2010).

2 International Environmental Regimes: A Review of the Literature

International regimes and institutions play a central role in global environmental governance.[2] As a result of the increasing interdependence and interconnectedness in world politics, states are largely unable to isolate themselves from outside events (Young 1999b: 1). Consequently, there is an increase in collective action problems related to international public goods, commons and shared natural resources. As a response, international cooperation among states, pursuing global solutions, represents one approach of answering the call for governance without government.

Since the 1972 United Nations Conference on the Human Environment, international environmental regimes have proliferated, a development that has been even more pronounced since the 1992 UN Conference on Environment and Development in Rio de Janeiro. Today, more than 200 multilateral treaties regulate environmental problems ranging from the overexploitation of natural resources to problems of global environmental change, such as climate change or biodiversity loss (Carter 2007).

This chapter aims to investigate under which conditions international environmental regimes emerge and can achieve their goals. Special emphasis is put on factors accounting for both their formation and implementation.

International regimes are governance arrangements aiming at social regulation, with a specific focus on the convergence of interest between its members. International regimes are either bilateral (for example two states agreeing on joint efforts to control acidification in a lake that crosses national borders) or multilateral, i.e. open for all states, or at least for a regional group of states (consider the United Nations Framework Convention on Climate Change or the Convention to Protect the Mediterranean Sea). In accordance with the consensus definition, international regimes are defined in this report as "implicit or explicit principles, norms, rules, and decision-making procedures around which actors' expectations converge in a given area of international relations" (Krasner 1983: 2).

International regimes can be understood as a specific type of international institution, which differ from formal international organizations, such as official United Nations bodies or the World Trade Organization. This difference is essentially explained in two ways. Firstly, regimes are understood as issue-specific institutions, i.e. aiming at coordinating interests and policies regarding a single problem, such as ozone depletion, climate change or transboundary air pollution. International organizations, however, typically cover multiple issues by their mandate. Secondly, regimes are distinctive from organizations as they do not possess the capacity to act as a unified actor, which is something that defines an organization (Hasenclever et al. 1997: 10-14).

International environmental regimes also share certain characteristics stemming from the fact that global environmental problems have attributes distinguishing them from other policy problems. This is an important factor to be taken into account when

2 Throughout this text, we use the terms institutions, regimes, and organizations. While related, these are distinct concepts. Thus, an institution can be understood as a "cluster of rights, rules, and decision-making procedures that gives rise to a social practice, assigns roles to participants in the practice, and guides interactions among occupants of these roles" (Young et al. 2008: xxii). Regimes, conversely, are a particular sub-type of institution, distinct because of their issue-specific focus. Organizations are another institution sub-type, which may have a broader mandate than regimes, in addition to legal personality.

theorizing about how and why environmental regimes are formed, their main characteristics and institutional design. Some of the characteristics identified in the literature include:

- Many environmental resources are 'public goods', which are likely to cause collective-action problems;
- Problems of global commons are usually transboundary, and thus require action from the international community;
- Environmental problems are often characterized by high uncertainty and complexity, especially when they play out on a global scale;
- Dealing with uncertainty is influenced by the irreversibility of environmental problems (e.g. precautionary approaches can be taken);
- Many environmental issues are complicated because their impact is long-term and affects future generations, whereas the remedies should be adopted by current generations;
- Governments are often characterized by administrative fragmentation while environmental problems are often cross-sectoral;
- Environmental damage as a by-product of other activities often requires regulatory intervention, thus increasing the historic tension between economic growth and environmental protection (Carter 2007: 174-180).

To solve these global environmental problems will call for deep behavioural, technological and institutional changes. Agreeing on and implementing such changes may be costly, and characterized by doubt regarding what the best measures and instruments facilitating change are. This raises questions concerning the effectiveness of these regimes in addressing the problems that led to their creation in the first place. Scholars have studied these issues with various different approaches to defining and measuring regime effectiveness (See Haas, Keohane and Levy 1993; Young 1999a; Young 2001; Miles et. al. 2002). For example, common measures of regime effectiveness include the behaviour change that occurred because of a regime, to what extent a regime has met its goals, whether it has solved the environmental problem it addresses (note that the goals of the regime are not inevitably equivalent to solving the environmental problem), and implementation of the regime's rules. Furthermore, regime rules rarely cover all dimensions of a problem. However, a regime can only influence behaviour, achieve its goals, and address an environmental problem once it has been implemented (Underdal 2002). Thus, while successful regime implementation may not be sufficient to guarantee regime effectiveness, we consider it a necessary precondition for effectiveness. However, the purpose of this chapter is not to engage in a thorough discussion of the main theories on effectiveness per se, but rather to focus only on specific determinants of regime performance.

Generally speaking, different problems require different solutions. Or, in other words, problems that have the same attributes are more easily managed by comparable instruments. Therefore, the first step of analysis is identifying the attributes of the problem, and the environment within which the development takes place – *context variables* – in order to seek directions for appropriate remedies – *regime design*. This process is often referred to as *institutional diagnostics* (Young 2008).

First, we believe it is important to distinguish between two different stages of *regime development*. Conventionally, *regime formation* refers to the stage at which a new set of rules and regulations is created, while during *regime implementation* members adapt to these new rules and behavioural change occurs. This way of thinking about regime development builds on the assumption that institutions and regimes matter to

the extent that their provisions are both stringent and inclusive, and that their members comply with these provisions (Underdal 2002: 6).

Secondly, we see the evolution and operation of regimes as a long-term process, which is affected by various characteristics over time. During the regime formation stage, the attributes of the environmental problem – here labelled *problem structure* – are influential. Furthermore, specific characteristics affect the context of actual international negotiation at conferences – we will refer to this as the *negotiation process*. The negotiation affects and is affected by the constraints and autonomy of the negotiating countries and the ultimate targets (e.g. companies) of the envisaged regulations – labelled *actors*. Furthermore, other institutions, organizations or norms in the wider international system influence both the negotiation and actors' preferences – labelled *regime environment.* These four concepts represent the context variables for regime formation. If the conditions in each area are favourable, regime formation will be likely.

During the regime implementation stage, problem structure, actors and regime environment will still influence the success of regime implementation. The negotiation phase, however, is no longer important. Instead, the success of implementation also depends on different choices and components of the institutional structure – labelled *regime design*. Assuming that these four context variables – problem structure, actors, regime design and regime environment – are favourable, regime implementation (i.e. potential effectiveness of the regime) will be likely.

The framework is depicted in figure 2.1 and the next sections will discuss each of these conceptual building-blocs in some more detail and indicate which rules we have derived from this. However, note that the literatures on the different issues such as *problem structure, negotiation process, actors, regime environment* and *regime design* has considerable overlaps, therefore aspects pertaining to *problem structure*, for example, can also appear in the rules listed under *actors*. In chapter 3, for each of these rules key concepts will be defined and appropriate indicators identified to implement these rules in a model.

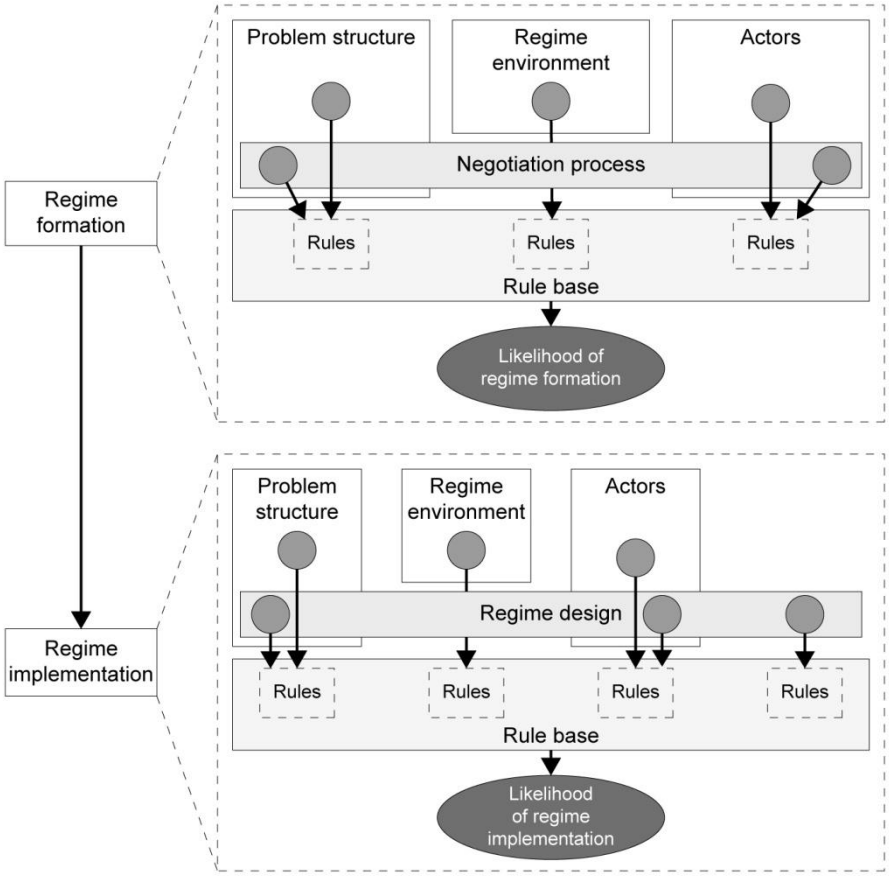

Figure 2.1 Conceptual framework for the analysis of the likelihood of regime formation and regime implementation.

2.1 Problem Structure

Each environmental problem has distinguishing features that define its degree of difficulty and complexity. Consequently, different problem types call for different solutions. Those in favour of a problem-structural approach argue that the type of the problem is the single most important factor explaining difficulties in regime formation (Rittberger and Zürn 1991) and determining the success of problem-solving (Underdal 2002).

Scholars use terms such as 'problem structure', 'nature of the problem' or 'character of the problem' (Young 1999b: 50-77; Miles et al. 2002; Hovi, Sprinz and Underdal 2003), despite a lack of consensus on what this actually is. The section below provides a short description of some of the key characteristics of problem structure found in the literature, which, in Chapter 3, are distilled into concrete rules for regime formation and implementation.

One aspect of problem structure that needs to be taken into account is the distribution of costs and benefits, and other more strategic considerations such as economic competitiveness (Victor et al. 1998: 9). Solutions to some problems can have significant environmental benefits at relatively low cost, whereas in other cases the cost of action is high, but the environmental benefits are not yet clear, thus deterring actors from regime formation.

Moreover, participating in regimes addressing environmental problems may threaten a country's economic competitiveness, thus discouraging countries from unilateral action unless there are guarantees that their economic competitors will also participate in the regime (Victor et al. 1998). Furthermore, problem structure is defined by the characteristics of the activity causing the problem, such as the number of the actors involved, the effect of economic incentives, the role of multinational corporations, and the concentration of the activity in question to the major countries (Brown Weiss and Jacobsen 1998b: 521-535).

Additionally, the character of the problem can refer to two different aspects of malignancy (Underdal 2002: 15-17). Firstly, the intellectual complexity of problems can vary: we may not have sufficient scientific knowledge to address the problem with appropriate solutions. Overcoming this problem requires significant investment of intellectual capital, so that more research on the problem and possible suitable treatments can be done. Secondly, problems can also vary in malignancy from a political perspective. Global environmental problems in particular, which require collective action, can be seen as malign or benign depending on the degree of divergence of the interests and preferences between the various actors involved in causing and addressing the problem. Hence, a benign problem is constituted by shared common preferences by all actors, whereas a malign problem would suggest that all actors have contradicting interests (Underdal 2002).

A further concept applied to problem structure is irreversibility, referring to a situation where failure to take action may lead to severe losses, for instance the depletion of fish stocks or extinction of endangered species. Such abrupt changes have and will continue to occur in many ecological systems. Institutions created to address such problems need to focus more on mechanisms that ensure adaptive management and also on promoting consensual knowledge on the problem, for example by continuous research and monitoring (Young 2008: 125).

As the discussion above indicates, the characteristics of problem structure that affect regime formation and implementation relate to issues such as the availability of information, the cost of addressing it, the type and number of actors affected by the problem, as well as the compatibility of their interests. Building on these characteristics, the following types of problems are distinguished:

Collaboration problem

Collaboration problems or problems of incongruity refer to situations where the costs and benefits of a problem and potential solutions are unevenly distributed in favour of some actors (Underdal 2002: 20). Characteristic examples of such cases are problems of transboundary pollution, or common-pool resources. Often, a country that pollutes neighbouring ones only pays a part of the costs, but enjoys all the benefits. Similarly, free-riders of common-pool resources enjoy short-term catches while sharing only part of the long-term costs of stock depletion. These problems can be caused either by externalities or by competition (Young 1994: 91-95).

Coordination problem

Coordination problems, on the other hand, still require cooperative efforts, but with the difference that actors' preferences and interests converge. Typical examples of such problems are measures to control air or marine traffic. In coordination problems, the main issues are imperfect information and communication, therefore these areas should be targeted (Underdal 2002).

Systemic environmental problem

Systemic environmental problems refer to a specific understanding of the functioning of the global system. While the activities causing systemic problems do not necessarily take place at a global scale, their physical impacts are global. Emissions of greenhouse gases or ozone depleting gases are, thus, systemic environmental problems: although the emission of these gases is asymmetrically distributed through at the world, they spread throughout the whole atmosphere (Turner et al. 1990).

Cumulative environmental problem

In the study of international environmental regimes, cumulative problems similarly refer to a specific understanding of the functioning of a global system. However, in difference to systemic problems the causes of cumulative problems are local in nature but widely replicated, consequently leading to a change in the overall environment (Turner et al. 1990). This includes changes to distinct local and regional ecosystems such as forests, grasslands and wetlands. For example, the immediate implications of deforestation are restricted to the location where it occurs; however, the fact that it occurs in forests all over the world makes it a global environmental issue. Furthermore, biogeochemical flows that remain below globally systemic scale in their movement are also included in the category of cumulative environmental problems. These include for instance sulphur and nitrogen oxide flows, as well as the issue of water pollution.

Regulation costs

According to many scholars (e.g. Barrett 1999; Biermann and Siebenhüner 2009b), the costs actors face by complying with the rules of a regime are an important explanation for why regimes form, and also how difficult it is to solve the environmental problem. However, regulation costs are not fixed, as for example technological innovations can reduce regulatory costs, while prolonged inaction may lead to an increase in the costs of reversing the damage.

Public concern

Studies of several regimes have indicated that the level of public concern may be an important variable in the formation and development of regimes. For example, in the case of the Oslo Convention for the Prevention of Marine Pollution by Dumping from Ships and Aircraft, a high-profile toxic waste dumping incident triggered increased public concern, media coverage and campaigns by environmental groups, all of which encouraged agreement on the Oslo Convention (Skjærseth 2002: 68). Public opinion has also been influential in the creation of a regime addressing the sea dumping of low-level radioactive waste, measures to address international oil pollution (in this case, also often triggered by tanker accidents and similar events), and the development of the International Whaling Commission (Andresen 2002; Carlin 2002; Miles 2002).

On the role of NGOs in raising public interest on an environmental issue, see also the paragraph on Participation in section 2.4.

Scientific uncertainty

A lack of scientific certainty regarding the effects of an environmental issue may pose barriers for the formation and development of regimes. For example, in the case of the

Oslo Convention mentioned in the previous paragraph, states have in the past argued against more stringent rules regarding specific issues on the basis of lacking scientific evidence on the environmental damage caused by substances that were being dumped in the North Sea (Skjærseth 2002: 69, 80-81). Scientific uncertainty also played a role in controversies regarding the setting of adequate total allowable catch quotas for the International Whaling Commission (IWC) and several fishing regimes (Andresen 2002).

The following rules were derived from the regime literature on *problem structure:*

A1. The higher the **regulation costs**, the less likely is regime formation.
A2. High **public concern** for the problem increases likelihood of regime formation.
A3**. Systemic problems** increase the likelihood of regime formation.
A4. **Cumulative problems** decrease the likelihood of regime formation.
A5. **Scientific uncertainty** decreases the likelihood of regime formation.
A6. In case of a **collaboration problem**, regime formation is less likely.
E1. In case of a **collaboration problem**, regime implementation is less likely.
E2. The higher the **regulation costs**, the less likely is regime implementation.
E3. **Systemic problems** increase the likelihood of regime implementation.
E4. **Cumulative problems** decrease the likelihood of regime implementation.

2.2 Negotiation Process

Another important factor for regime formation and regime success is the negotiation process. The negotiation process through which actors agree on a regime is affected by the cost of negotiation, whether and to what degree rules are differentiated, the availability of side-payments during the negotiations, and whether the issues to be negotiated create cumulative or crosscutting cleavages. Thus, these issues will be explored under the subsequent sub-headings.

Negotiation costs

Negotiation costs are the time and resources invested into negotiation procedures during the initial stages of regime formation. After this stage, the costs associated with a regime and its implementation depends on the regime design.

It is difficult to estimate the actual economic costs incurred during the establishment and operation of an institution, as its tasks are not always funded from the budgets of the individual participants (Mitchell 2008). Especially when the institutions are in place to coordinate the activities of other actors (such as individual users of common pool resources), such estimations are quite difficult (Ostrom 1990).

Differentiation of rules

In the international society, there is the tendency to treat all actors equally, particularly in order to respect issues of national sovereignty. However, in recent years there has been a move towards adopting the principle of common but differentiated roles and responsibilities in international agreements (Young 2008). When dealing with global environmental problems, it is especially common that the various actors are responsible for the environmental problem to different extents, which do not

necessarily match the extent to which these actors suffer from the environmental damage caused.

Side-payments

Side-payments can either be incentives for participation in a regime (such as transfer of money), or payment for non-use of a resource (Underdal 2002).

Cleavages

Cleavages between negotiating parties are cumulative when negotiating coalitions are distinct and rigid with little overlap. In these cases, a group of actors may find that they agree on all dimensions of a problem, while they do not have any crosscutting interests with other actor coalitions. This makes negotiations difficult. Conversely, cleavages are crosscutting when actors have shared interests with different groups, rather than forming discrete coalitions. In such cases, there is more room for bargaining, compromises and making deals (Underdal 2002: 19-20).

The following rules were derived from the literature on *negotiation processes:*

B1. The higher **the negotiation costs**, the less likely is regime formation.
B2. If a problem is marked with great asymmetry of powerful states' interests, **differentiation of rules** increases likelihood of regime formation.
B3. If a problem is marked with great asymmetry of interest between important states within the issue area, **differentiation of rules** increases likelihood of regime formation.
B4. In case of a collaboration problem, the more **side-payments** are made available, the more likely is regime formation.
[B5. In case of high transaction costs and scientific uncertainty, an **initial framework treaty** followed by more precise agreements increases likelihood of regime formation.]
[B6. If the environmental problem is considered urgent by a majority of actors, an **initial informal agreement** increases likelihood of regime formation.]
[B7. In case of cumulative cleavages, regime formation is more likely if there are **positive or negative incentives.**]
[B8. In case of a collaboration problem, regime formation is more likely if there are **positive issue-linkages**.]
[B9. In case of **cumulative cleavages**, regime formation is less likely.]

2.3 Actors

The interests and power of actors (especially states) are often seen as important factors in explaining the formation and operation of international regimes. In a functional approach, international regimes are formed when it is in the interest of powerful states, for example because they expect to gain more than they lose by participating in the regime (Hasenclever et al. 1997: 3-5). This focus on state interests, building on neoliberal and game-theoretical arguments, represents a mainstream approach to regime theory. Cooperation between states is a way to reap joint gains, and institutionalizing the cooperation helps reduce uncertainty of estimates of future benefits (Young 1989). Furthermore, those focusing on relative power capabilities between states in the international system emphasize the role of powerful actors in

pushing for regime creation, and at later stages deterring other states from deviating from the commitments (Hasenclever et al. 1997: 85-89). Considering the relevance of these issues, the following paragraphs will outline the relevance of interest asymmetry, powerful states, homogeneity of actors (as a determinant of conflicting or overlapping state interests), and number of economic sectors involved for the formation and implementation of regimes.

Asymmetry of interest

A problem is asymmetrical when the interests of the parties involved are negatively correlated, or the values they ascribe to particular species or elements of nature are incompatible with each other (Underdal 2002: 17-20). The typical example of this case is upstream-downstream pollution: if no measures are taken, the polluters will gain all the benefits from the polluting action without any costs, while if abatement measures are implemented, they will suffer all costs unless measures take this asymmetry into account.

Powerful states

The argument that support for regime creation from powerful states is important has its origins in hegemonic stability theory. Those favouring this theory do not necessarily consider international organizations and institutions as a pure public good, but rather a political tool for powerful states (Hasenclever et al. 1997: 86-99). While this has probably been the case with many institutions in more high-politics sectors, it has been presented as less likely in the environmental field (Breitmeier et al. 2006).

Nevertheless, it has been proven that even during the negotiation of environmental agreements, individual powerful states can play a crucial role. A way to conceptualize this is to look at political leadership, as well as the distribution of power within the system, and how these factors influence regime formation under different conditions (Underdal 2002: 30-32).

This discussion has also been staged under the term ‘pushers and laggards’. ‘Pushers’ are those state actors that are in favour of the agreement, hence they put a lot of effort in achieving cooperation and regime formation. Conversely, ‘laggards’ are those state actors that are either not in favour of the agreement, or that do not particularly benefit from it (Underdal 2002).

As mentioned earlier, power in the negotiation and operation of an international regime can be concentrated in the hands of a single powerful state, shared by some actors, or dispersed among all actors. In the latter case, where all state actors possess equal power, high transaction costs should be avoided, as this would jeopardize the accomplishment of cooperative agreements.

However, not only support of powerful states can support regime formation: the participation of high-level ministerial representatives from the negotiating countries rather than lower-level delegates can encourage agreement, as political pressure on decision-makers is increased (Skjærseth 2002; 2006).

Furthermore, while the distinction is not always clearly made in the literature, it is important to differentiate between states that are powerful, and states that are important for the creation of a regime governing a particular issue due to their stake in the cause and/or solution of the problem. For example, in the case of the International Whaling Commission, participation by traditional or aboriginal whaling states was definitely important for addressing the problem of whaling (Andresen 2002). However,

not all of these states can necessarily be considered powerful in terms of their material and symbolic resources.

Important states are furthermore significant since the outvoting of important states could diminish their support for regime formation. In practice, such problems have generally been avoided: most regimes implicitly or explicitly rely on consensus rules. For example, while both the Vienna Convention and the Montreal Protocol allow for majority decisions that would be binding for outvoted states, in practice a "flexible consensus" has been used to balance the different interests of important states (Wettestad 2002: 161). In fact, the International Whaling Commission is one of the few examples of international environmental regimes where important states within the issue area were outvoted (Andresen 2002).

Homogeneity of actors

The homogeneity or heterogeneity of actors determines their preferences regarding the agreement in question. For example, it has been noted that agreements are more easily reached in institutions with fewer participants, as this usually implies less heterogeneity (Gehring and Oberthür 2006: 340; Snidal 1994). Furthermore, homogenous actors may share common characteristics such as economic conditions, power, size, culture, worldviews, consensus in policies, etc.

Economic sectors

When multiple economic sectors need to be regulated to address an environmental issue, this may affect both regime formation and regime implementation negatively. This is because "transsectoral problems require concerted action among relevant public authorities both horizontally, and vertically": several agencies and ministries may be affected by the task of regulating the issue and have to coordinate amongst each other, in addition to the relevant ministries of other countries (Skjærseth 2002: 179). This indicates that the task of coordination may impede implementation, even with the best intentions (Skjærseth 2002).

The following rules were derived from the regime literature on *actors:*

C1. In case of a systemic environmental problem, non-support of one or more **important states within the issue area**, decreases likelihood of regime formation.
C2. In case of a cumulative environmental problem, the more of the **important states within the issue area** support a regime, the more likely is regime formation.
C3. Great **asymmetry** of **powerful states' interests** decreases likelihood of regime formation.
C4. Great **asymmetry of interest** between **important states within the issue area** decreases likelihood of regime formation.
C5. If almost all **powerful states** support regime formation, then regime formation is more likely.
C6. If almost all **important states within the issue area** support regime formation, then regime formation is more likely.
C7. The **fewer economic sectors** are needed to regulate an environmentally harmful activity, the more likely is regime formation.
C8. If the **states** needed to regulate a harmful activity are **homogeneous,** then regime formation is more likely.
[C9. If the environmental problem is considered **urgent** by **the majority of states**, then regime formation is more likely.]
[C10. If the **coalition of 'pushers'** is **more powerful** than the rest, regime formation is more likely.]
[C11. If the **coalition of 'laggards'** within a regime is **more powerful** than the rest, regime formation is less likely.]
F1. **Participation of high-level government** representatives in COPs increases likelihood of regime implementation.
F2. If almost all **powerful states** participate in a regime, then regime implementation is more likely.
F3. If almost all **important states within the issue area** participate in a regime, then regime implementation is more likely.
F4. The fewer **economic sectors** are needed to regulate an environmentally harmful activity, the more likely is regime implementation.
F5. In case of a systemic environmental problem, non-participation of one or more **important states within the issue area**, decreases regime implementation.
F6. In case of a cumulative environmental problem, the more of the **important states within the issue area** participate in the regime, the more likely is regime implementation.
[F7. **Outvoting** of **important states within the issue area** decreases regime implementation.]
F8: Great asymmetry of interest between **powerful states** decreases likelihood of regime implementation.
F9: Great asymmetry of interest between **important states within the issue area** decreases likelihood of regime implementation.

2.4 Regime Environment

This section discusses a number of factors in the institutional environment of an international regime, such as the interlinkages with other regimes in the same of adjunct issue areas.

Institutional interplay

Some environmental regimes are formed and operate successfully without significant interaction with other institutions. This is usually the case where there are not many other institutional arrangements dealing with aspects of the same problem. However, these cases are rare, and over time more and more interdependencies arise between anthropogenic activities and the institutional arrangements to control them. Hence, at the global level, regimes of a similar nature often contradict each other, as is the case with the climate change and the ozone depletion regimes (Young 2008: 123-124). Environmental regimes may also be in conflict with arrangements of the World Trade Organization, when trade is one of the areas they interfere with in the process of addressing an environmental problem. Moreover, a global institution can face interactions at the national level, either if the policy measures it imposes are unfamiliar to the governments, or if its provisions exceed national authority.

Institutional interaction exists when one regime affects either the development or the effectiveness of another regime (Oberthür and Gehring 2006). However, this does not necessarily imply a two-way influence between the institutions in question, but rather a unidirectional influence from the source institution (the one exerting the influence) to the target institution. There are four causal mechanisms of interaction according to which two institutions may be linked (Oberthür and Gehring 2006). Firstly, cognitive interaction refers to a transfer of knowledge. This can take place between any two institutions, since learning can happen even when no common issue areas or actors are involved. Secondly, interaction trough commitment can occur between institutions that overlap in issue area or actor memberships: commitments taken in the source institution can influence the interests and the decision-making process in the target institution. Thirdly, behavioural interaction refers to behavioural change among actors within an issue area. This affects the performance of the target institution directly without requiring a decision, and usually occurs among non-state actors. Finally, impact-level interaction refers to situations where the effect of the target institution is a direct spill over of the effects of the source institution (Oberthür and Gehring 2006). Institutional interaction can also have the forms of horizontal or vertical interaction. The former occurs between institutions or policies at the same level, whereas the latter occurs at different levels, for instance between an international and an EU institution.

Participation

The importance of transparency and participation in environmental affairs is widely recognized. A first step in this direction was the adoption of the Aarhus Convention on Access to Information, Public Participation in Decision Making and Access to Justice in Environmental Matters in 1998.s

Active participation by the stakeholders that are the targets of regulation often increases the effectiveness of the implementation process (Victor et al. 1998: 665). This is because stakeholders have the best information concerning the feasibility and costs of implementation, furthermore involving them may increase their interest in the success of the institutional arrangement (Victor et al. 1998).

When non-compliance with an agreement is based on the perception that it is unfair or inadequate for the parties addressed by it, the key solutions are increased participation in the decision-making process by all relevant actors, and impartiality in the enforcement of the agreement (Breitmeier et al. 2006: 63-112). Public participation is important to achieve this. For example, NGOs can increase public interest and thus put issues higher up on political agendas, and they can contribute to transparency by

publishing information that governments either do not possess or are afraid to reveal. Greenpeace and TRAFFIC, for example, have played important roles by providing information regarding ocean dumping and the illegal trade of endangered species, respectively (Brown Weiss and Jacobson 1998a).

Further actors whose participation in the regime formation process may be important are scientific advisory bodies and networks of experts, whose role in creating consensual scientific knowledge is often highlighted (Underdal 2002: 36).

Some of the context variables reviewed above, such as those related to the negotiation process, are only relevant for regime formation. However, most of the context variables discussed above (e.g. those relating to actors, problem structure, regime environment) are relevant for both regime formation and implementation. As these three context variables may change between the different regime stages,[3] they are included both in the formation and implementation stage of the conceptual framework developed in this paper. Following this review of the context variables affecting the initial formation and implementation of international regimes, in the following section we will discuss context variables associated with 'regime design', which plays an important role in the subsequent stage of regime implementation.

The following rules were derived from the regime literature on *regime environment:*

D1. The existence of a **preceding international agreement** dealing with the same or a similar problem enhances the likelihood of regime formation.
D2. **Consensual scientific information** by **scientific advisory bodies** increases the likelihood of regime formation.
[D3. **Participation by stakeholders** in decision-making increases the likelihood of regime formation.]
H1. The embedding of a regime in a **larger institutional framework** increases the likelihood of regime implementation.
H2. **Negative interplay** with other regimes decreases regime implementation.
[H3. **Positive interactions** with other regimes increase regime implementation.]
[H4. **Participation by stakeholders** in decision-making increases the likelihood of regime implementation.]

2.5 Regime Design

After reviewing the context variables and how these affect the formation and implementation of a regime, this section examines regime design, which plays an important role in regime implementation.

Scholars have been occupied with the question 'Do regimes matter?' for a long time (cf. Mitchell 1994a). Numerous studies published in the last two decades have convincingly demonstrated that regimes do induce behavioural changes among the actors that are responsible for an environmental problem, and that they also contribute (to a lesser extent) to solving these environmental problems. As a consequence of this general agreement about the relevance of international

3 For example, while many states may affect regime formation, once the regime has been established, the most important states for implementation are those that are actually participating in the regime.

environmental regimes, the focus shifted towards other important questions, such as the specific conditions under which regimes matter. Hence, the focus shifted towards institutional design.

Naturally, the character of the problem as well as the political environment in which regimes are created and operate are important determinants of effectiveness, according to many scholars even more so than institutional design. However, regime design is the only attribute that policy makers can deliberately affect. More importantly, as Ostrom (1990) observed, it is important to devise certain design principles that potentially enhance effectiveness in terms of problem solving, or tend to increase the robustness and resilience of the institution to carry on over time.

With regard to institutional characteristics, several important variables have been identified. For instance, access procedures and participation rights, decision-making rules, the role of the secretariat, the structuring of the agenda, the organizational structure of the science-policy interface, and verification and compliance mechanisms have been theorized to improve regime effectiveness (Wettestad 1999: 18-42; Andresen and Wettestad 2004).

In addition, institutional design can refer to the equity of the obligations, their precision, the scientific and technical advice provisions, the monitoring and reporting requirements, the secretariat's role and the various incentives and sanctions used to prevent low compliance (Brown Weiss and Jacobson 1998b: 523-528.

The nature of commitments is of crucial importance in successfully dealing with an environmental problem (Victor et al. 1998: 12). For example, in the case of oil pollution at sea, a drastic change in the regulations proved highly effective (Mitchell 1994a; Mitchell 1994b).

Due to the nature of the problem they are meant to regulate, certain regimes provide opportunities for their members to engage in corrupt or manipulative behaviour. Examples of such behaviour include illegal logging, or illegal, unreported and unregulated fishing (Young 2008). Moreover, regarding institutions designed for the management of common pool resources in cases of corrupt regimes, officials can be bribed to authorize rule changes or similarly ignore cases where actors do not comply with legal requirements but rather enforce rules of their own (Ostrom 1990: 200). In addition, influential actors can bribe officials in order to prevent specific rule changes. When corruption prevails, institutional design must focus on compliance and enforcement mechanisms (Young 2008: 128).

In the following paragraphs, these issues will be discussed under the headings of scientific knowledge generation, programmatic activities, decision rules, compliance and compliance mechanisms, positive incentives and sanctions, verification/monitoring mechanisms, Systems for Implementation Review, regime secretariats, and autonomous standing decision-bodies.

Scientific knowledge generation

Since many environmental problems are characterized by high scientific uncertainty, improved scientific understanding could eventually lead to improvements in the way the problem is managed or solved. Therefore, one of the indicators of regime effectiveness could be the extent to which a particular regime promotes knowledge about the problem it was designed to tackle (Mitchell 2008). Such promotion of knowledge could take place in various ways, either directly or indirectly. The indirect way is by promoting awareness to the public, thus raising the salience of the problem on the global and national policy agendas. From that moment onwards governments

and other public or private actors (e.g. the EU or corporations) allocate more resources to research and development addressing the particular problem. In a more direct way, a regime can engage in various activities, such as programmatic activities, as part of a larger regulatory effort. Many scholars suggest that institutional influence in scientific understanding can lead to behavioural and policy changes, which can in turn lead to the solution or improvement of the environmental problem (Andresen et al. 2000; Mitchell 2008).

Another way of promoting production of knowledge is through Global Environmental Assessments, which are large-scale international scientific assessments. A well-known example of this is the work of the Intergovernmental Panel on Climate Change. Mitchell et al. (2006: 1-28) suggest that GEAs have significant influence on political decisions regarding the tackling of environmental problems, both at a global and at a local scale. These assessments serve as arenas where science and policy largely interact. However, Mitchell et al. (2006) conclude that the level and type of influence depends on other circumstances as well. Influence also varies according to different potential audiences: an audience may be more influenced by an assessment if it considers the assessment to be salient, credible and legitimate. This also depends on the involvement of stakeholders in the assessment, thus giving them a sense of 'ownership'. Lastly, these assessments are more influential when actors' capacity to contribute to the assessment and their ability to understand and process the information is supported.

However, the importance of fostering an open-ended process of knowledge creation is greater in the case of environmental than other international institutions. Apart from monitoring, the dissemination of scientific information to all the members of the regime as well as the publication of the countries' environmental performance are important tools allowing the identification of lacking national implementation of regime requirements. Such activities could make use of expert transnational networks (in the form of scientific councils or international NGOs) and would enhance the international contractual environment within which the regime operates (Haas et al. 1993).

Programmatic activities

Programmatic activities refer to organized efforts of international regimes, which aim at improving their operation, and can have the form of scientific assessment and monitoring, research, systems of implementation review, etc. Usually, there are specific bodies or components/programs dealing with such activities within a regime. For example, under the United Nations Framework Convention on Climate Change, there are two bodies designed to perform such activities. The Subsidiary Body for Scientific and Technological Advice (SBSTA) deals with scientific and technical information, and the Subsidiary Body for Implementation (SBI) deals with compliance and implementation review (Breitmeier et al. 2006: 191-226). Sometimes such a body can be the core of a regime, as in the case of the Mediterranean Action Plan. In that case, the 'Co-ordinated Pollution Monitoring and Research Programme in the Mediterranean', which is widely known as MED POL program, deals with research and monitoring on marine pollution and has played a tremendous role in the first years of the regime's operation (Frantzi and Lovett 2008). Empirical evidence from Breitmeier et al. (2006) suggests that such programmatic activities enhance the consensual knowledge on the problem that led to the creation of the regime. However, there is no clear link between knowledge enhancement and environmental improvement.

Some international environmental regimes are designed from their outset with a clear purpose to enhance scientific knowledge on an environmental problem. The 1959 Antarctic Treaty, for instance, explicitly states that its goal is "to promote international cooperation in scientific investigation in Antarctica" (Breitmeier et al. 2006:193). In contrast, there are cases where there is no need for inclusion of activities such as assessment, monitoring and research in a regime. This is the case where other bodies like intergovernmental organizations have already carried out such activities; the necessary knowledge consensus is therefore already established. An example of such a regime is the MARPOL convention, which thus could focus on implementation and compliance instead (Mitchell 1994a).

Decision rules

Decision rules specify the conditions that must be met to reach collective decisions in the context of an international regime. These can be simple or other types of majority rule, unanimity or consensus. A simple majority rule requires the consent of 50 percent plus one of those eligible to participate in decision-making to agree on a decision for it to be legitimate and authoritative. A qualified majority rule can require agreement of any fraction beyond that, such as 2/3 or 3/4 of eligible participants. A unanimity rule requires all of the participants to explicitly agree for a decision to be legitimate and authoritative. A consensus rule differs from that of unanimity in that not all participants have to explicitly agree with a measure, but no party can disagree so strongly that it is willing to oppose the measure's adoption publicly and formally (Breitmeier et al. 2006: 114-115). The usual practice in international regimes is consensus or in extreme cases unanimity. Decision rules and procedures are occasionally considered to be by far the most important determinant of institutional capacity to combine interests and preferences of actors into cooperative results (Underdal 2002: 24-26). A theoretical debate focuses on the high transaction costs of unanimity in contrast to the loss of individual welfare arising from more hierarchical procedures on one hand, and the view that members that acknowledge the legitimacy of a regime will not mind about the decision rules employed on the other (Breitmeier et al. 2006: 113-190). Empirical evidence from the same authors suggests that consensual rules increase goal attainment, and to a lesser extent even problem solving. Consensus turns out to be a rather flexible rule for two reasons (Breitmeier et al. 2006: 121): firstly, it can range from situations where all participants are keen and eager to adopt the decision, to situations where participants accept decisions only to avoid being in record as opponents. Secondly, a decision reached by consensus can later on be used as a persuasion instrument for reluctant participants to conform to the terms of a regime.

Compliance and compliance mechanisms

Compliance by all members of a regime does not guarantee its effectiveness. However, according to some scholars compliance can be one of the attributes of effectiveness. Thus, compliance is not the capacity of institutions to solve the problem that led to its creation, but rather the extent to which subjects comply with rules addressed to them (Breitmeier et al. 2006). Furthermore, compliance does not refer to their willingness, motivations or intentions, but rather to their actual behaviour in the end. This argument is based on the observation that many actors which are parties to international regimes may be willing to comply, but do not simply because they lack the capacity to do so (Chayes and Chayes 1995). However, as is often acknowledged in the context of the Kyoto Protocol, even full compliance is not sufficient to mitigate the

environmental problem if some major contributors to an environmental problem choose not to participate in the agreement at all.

The political hierarchy and monopoly on force that exist in the national context are no prerequisites for compliance and the enforcement of rules and regulations (Breitmeier et al. 2006). However, other horizontal mechanisms such as legitimacy, legalization, or responsiveness could achieve the same results (Breitmeier et al. 2006). Furthermore, the compliance mechanisms defined by a regime can be an important contributing variable for compliance. Regarding the strength or weakness of the mechanisms a regime uses to ensure compliance, this can be described in three levels. The weakest level is when there is no such mechanism at all. At an intermediate level, each party establishes a mechanism for monitoring regime implementation. Finally, a strong compliance mechanism not only monitors implementation, but also has the authority to apply sanctions on the non-complying parties (Young 1999b: 88-97).

Further issues that are important for compliance and compliance mechanisms are the precision of the rules established by the regime, as well as to what extent they are legally binding. Therefore, scholars have also worked on evaluating to what extent a regime leaves room for interpretation regarding the goals and targets that are to be achieved, and whether the conditions of obligation are explicit (Abbott et al. 2000).

Positive incentives or side-payments

Positive incentives encourage reluctant states to participate in the agreement, and furthermore help them comply with its rules. Positive incentives are particularly important in cases of involuntary non-compliance, when states are willing to comply but lack the necessary capacity to do so. They can have the form of financial assistance, transfer of technological expertise, or other bilateral assistance outside the framework of the treaty. For instance, the Vienna Convention and its Montreal Protocol provided funding to the parties for conducting initial inventories of production and consumption of ozone-depleting substances, while the Climate Change and Biological Diversity Conventions provide funding to countries to meet the increasing costs of complying with the conventions' obligations (Brown Weiss and Jacobson 1998a). Similar mechanisms are the Clean Development Mechanism of the Kyoto Protocol, or others like the Global Environment Facility.

Sanctions

Various measures can function as sanctions, such as restrictions in the case of violation of the agreement's provisions, or even trade restrictions, which were used for example in the Montreal Protocol to discourage members of the regime from sell ozone-depleting substances to non-members. In other cases, sanctions take the form of a withdrawal of the privileges of membership to the agreement, for example the Charter of the United Nations stipulates that the voting rights of members who delay to pay their fees will be suspended (Breitmeier et al. 2006: 150). However, sanctions should not put substantial costs and burdens on the countries imposing a sanction (Breitmeier et al. 2006). Even though case studies reveal that compliance is not significantly promoted by sanctions, they have a value as a last resort instrument to ensure compliance (Brown Weiss and Jacobson 1998b: 548). Sanctions are especially important in the case of problems that allow participants to free-ride.

Many scholars argue that adaptive management can be useful where non-compliance is the result of the requirements of a regime proving to be impractical or parties lacking

the necessary implementation capacity, rather than parties deliberately choosing to cheat or finding the rules unfair (Breitmeier et al. 2006: 63-112).

Monitoring/verification of compliance

In the absence of hierarchy, other mechanisms are needed to ensure horizontal coercion. One possible measure is the verification of compliance. Whether verification is difficult or simple to achieve is heavily influenced by the institutional design (Mitchell 1994b; Wettestad 1999). Furthermore, verifiable international environmental agreements have better chances at successful negotiations, are also more likely to be implemented properly. Verification is 'the process determining whether a Party is in compliance' (Ausubel and Victor 1992). In order to fulfil this criterion, either a large costly new international or national organizational infrastructure needs to be created, or the necessary information must be collected by existing national organizations.

In many cases, other actors such as NGOs are involved in this process. However, verification is still mainly dependent on national reports, which might be unreliable or incorrect, especially when national interests are at stake. Hence, it could be the case that compliance is not achieved even if reporting indicates to the contrary.

Systems for Implementation Review

Systems for implementation review (SIRs) are rules and procedures governing how parties to international agreements exchange data, monitor activities, assess adequacy of commitments and handle poor implementation (Victor et al. 1998). SIRs operate by managing implementation problems, e.g. providing incentives and funding for capacity building, or by enforcing commitments with penalties, e.g. withdrawal from funding or other benefits. The former operation – management – is effective when poor implementation is due to low capacity and limited resources, whereas the latter can be really influential when previous management attempts have failed (Victor et al. 1998). Since monitoring and verification of compliance heavily depends on the availability of data, and national reports do not always allow for comparable and accurate information, the building of mechanisms for reporting and using data should be emphasized (Victor et al. 1998). Considering that the creation of such mechanisms requires a long time (often more than a decade), the necessary measures should be taken at the onset of regime formation.

Procedures of verification should be both affordable and reliable: for instance, military sanctions are always extremely costly for the parties that impose the sanction, whereas sanctions such as retaliatory tariffs are much easier to impose (Breitmeier et al. 2006: 74).

Secretariat

A strong secretariat can be central to the regime's implementation. To be characterized as strong, it has to be autonomous in developing policies, and have adequate financial resources (Biermann and Siebenhüner 2009a).

Autonomous standing decision-body

According to many scholars, the presence of an autonomous "standing decision-body rather than an ad hoc body or regular meetings of a Conference of the Parties increases compliance" of the parties to the agreement (Breitmeier et al. 2006: 63-112).

After reviewing the design features of international regimes, the following section continues by discussing the way in which these features affect the likelihood of regime implementation.

The following rules are derived from the literature on *regime design:*

G1. **Regime mechanisms that increase scientific knowledge generation**, synthesis and dissemination are likely to increase regime implementation.
G2. If a problem is marked with great asymmetry of powerful states' interests, **differentiation of rules** increases likelihood of regime implementation.
G3. If a problem is marked with great asymmetry of interest between important states within the issue area, **differentiation of rules** increases likelihood of regime implementation.
G4. In case of a collaboration problem, regime implementation is more likely if there is a **strong compliance mechanism**.
G5. Regime implementation is more likely if there are **side-payments**.
G6. In case of a coordination problem, regime implementation is less likely without a strong **information and communication mechanism.**
G7. The more **precise the rules** of a regime are, the more likely is regime implementation.
G8. **Legally binding rules** increase the likelihood of regime implementation.
G9. **Differentiated rules** increase the likelihood of regime implementation.
G10. The existence of a **strong autonomous secretariat** increases the likelihood of regime implementation.
G11. **Mechanisms for regular reporting and implementation** review increase the likelihood of regime implementation.
[G12. **Voting systems based on consensus or unanimity** lead to weaker decisions in regime implementation, which decreases regime implementation.]
[G13. Regimes with **broad issue coverage** are more likely to be implemented.]
[G14. Regime **mechanisms that increase public awareness** are likely to increase regime implementation.]

As this literature review has highlighted, a number of issues relating to the problem structure, negotiation process, actors, regime environment, and regime design affect the likelihood of regime formation and implementation. The following section outlines the rules derived from the issues discussed above, as well as how they were operationalised.

3 Operationalising the Conceptual Framework

After presenting the robust findings of regime literature on a number of factors that influence regime formation and subsequent implementation (and thereby the potential effectiveness of an international environmental regime), this section provides an overview of so called 'rules', statements that relate the findings of the literature review to the expected likelihood of regime formation and implementation.

In developing these rules, we took a number of decisions, which will be briefly elaborated upon. First, the development of the rules from the regime literature is based on expert judgments, but can of course be contested. The rules follow from robust findings of international regime literature, but they remain products of interpretation. Hence, different experts might disagree on nuances of how individual rules have been formulated. Second, it is important to note that the literature surveyed for this report is not a completely coherent body of literature in itself. Rather, it incorporates a wide range of underlying purposes and diverging concepts, which in turn necessitates interpretation. Third, not all relevant literatures on cooperation between states (such as game theory) could be included. The rules developed for this project are derived from a limited number of scholarly sources, thus guaranteeing a minimum coherence in terms of underlying ontological and epistemological assumptions. Fourth, in formulating the rules, we also had to accommodate specific requirements stemming from our aim to fit institutional theory into a computer model. Fifth, in the rules identified in the next section, we include only statements derived from our review of regime literature. Thus, even if the inverse statement of a rule seems plausible as well, it is only included here if the observation is supported by our review of regime literature.[4] In this way, it is ensured that the rules provide a fair representation of the current body of literature in this field. We, however, acknowledge that our theoretical bias towards neo-liberal institutionalism (regime theory) excludes other plausible accounts of the likelihood and effectiveness of international cooperation. Finally, the rules presented in this report are by no means meant to be a final set of rules, but rather a preliminary list that could be added on.

Further, we assume that a full model that is able to reproduce the results of real world cases (and eventually also predict the performance of a hypothetical regime) would need to take two distinct phases of regime effectiveness into account: regime formation (wherein the rules describe the likelihood for a regime to form under certain context conditions, actors constellations and specific factors pertaining to the negotiation process) and regime implementation (wherein the rules describe the likelihood of implementation of the regime under certain context conditions, actor constellations and specific factors of regime design).

The rules in each phase are organized in categories that relate to the discussion of regime literature provided above. Within each category (e.g. problem structure), the rules are grouped in no particular order. Rules that we believe to be valid and important, but for which we could not find a concise and feasible way to operationalise them are stated in the end of each category in square brackets.

[4] For example, while the literature provides evidence for the rule that "Great asymmetry of powerful states' interests decreases likelihood of regime formation", it does not indicate that low asymmetry of powerful states' interests particularly enhances the likelihood of regime formation. Therefore, in the computer model, we assume that low asymmetry of powerful states' interests has a neutral impact on the likelihood of regime formation.

Each rule is accompanied by a definition of its key concepts, followed by a short discussion of appropriate indicators to measure the individual components of the rule. Figure 3.1 provides a graphic representation of the conceptual model for the formation phase. In tables 3.1 and 3.2 we have summarized the determinants for each of the categories that determine regime formation (table 3.1) and regime implementation (table 3.2).

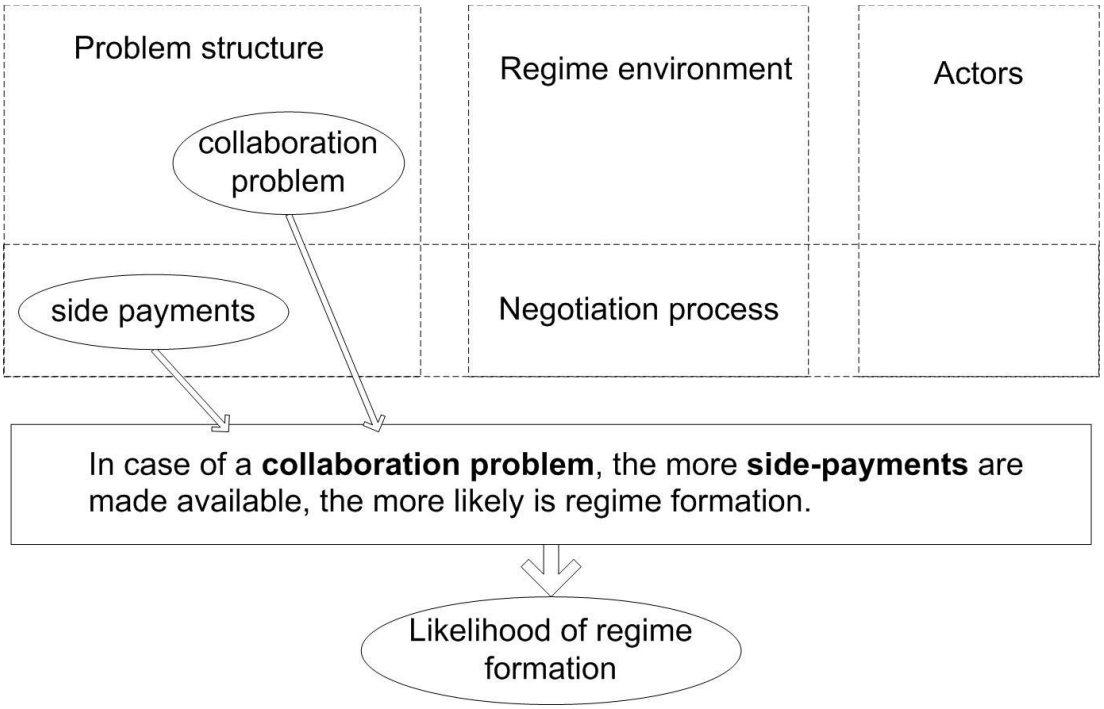

Figure 3.1 Model development: deriving rules from the literature on regime formation.

Table 3.1 Determinants of regime formation.

Problem Structure	Negotiation Process	Actors	Regime Environment
Regulation costs	Negotiation costs	Asymmetry of interest between powerful states	Preceding agreement
Public concern	Differentiated rules	Asymmetry of interest between important states within the issue area	Consensual scientific information
Systemic/ cumulative problem	Side-payments	Support from powerful states	
Scientific uncertainty	Transaction costs	Support from important states in issue area	
Collaboration/ coordination problem	Framework treaty	Number economic sectors	
	Informal agreement	Homogeneous states	
	Positive/ negative incentives	Urgency	
	Positive issue linkages	Cumulative cleavages	
		Coalitions of pushers/ laggards	

Table 3.2 Determinants of regime implementation.

Problem Structure	Regime Design	Actors	Regime Environment
Collaboration/ coordination problem	Mechanism for scientific knowledge generation	Participation of high-level government representation	Embedding in a larger institutional framework
Regulation costs	Differentiation of rules	Participation of powerful states	Negative regime interplay
Systemic/ cumulative problem	Compliance mechanism	Participation of important states within issue area	Positive regime interactions
	Side-payments	Number of economic sectors	
	Information and communication mechanism	Outvoting of important states	
	Precision of rules	Asymmetry of interest between powerful states	
	Legally binding rules	Asymmetry of interest between important states with in issue area	
	Strong autonomous secretariat		
	Mechanism for regular reporting and implementation review		
	Consensus or unanimity voting		
	Broad issue coverage		
	Public awareness mechanism		
	Sanction mechanism		

I. Regime Formation

A. Problem Structure

A.1. The higher the **regulation costs**, the less likely is regime formation.

Definition:

Regulation costs are the costs actors incur in the process of managing the environmental problem and fulfilling the rules decided upon in the regime.

Indicator:

The expected cost of action as calculated by secretariat working groups and scientific advisory bodies.

A2. High **public concern** for the problem increases likelihood of regime formation.

Definition:

Public concern for the environmental problem is the importance of an issue to the public.

Indicator:

Polls conducted on the public view during the formation phase of the regime and number of NGOs attending the negotiation. For example on ozone depletion, see Benedick (1998)

A3. **Systemic problems** increase the likelihood of regime formation.

Definition:

A **systemic problem** is when the activity that causes the environmental problem has a direct physical global impact, even though the activity in itself need not necessarily be of global scale.

Indicator:

The systemic meaning of global refers to the functioning of a system. According to this definition the activity need not be at global-scale, but the physical impacts of the activity need to be global in order to qualify as a globally systemic change. The problems of greenhouse gases and gases that deplete the stratospheric ozone layer are examples of systemic problems. Although the activity of emitting these gases is asymmetrically distributed in geographic terms over the globe, when released into the air, they spread in the whole atmosphere and thus have direct physical impact on a global level (Turner et al. 1990). For more examples and comparison see figure below.

Two types of global environmental change

Table 1. Types of global environmental change.

Type	Characteristic	Examples
Systemic	Direct impact on globally functioning system	(a) Industrial and land use emissions of 'greenhouse' gases (b) Industrial and consumer emissions of ozone-depleting gases (c) Land cover changes in albdeo
Cumulative	Impact through worldwide distribution of change	(a) Groundwater pollution and depletion (b) Species depletion/genetic alteration (biodiversity)
	Impact through magnitude of change (share of global resource)	(a) Deforestation (b) Industrial toxic pollutants (c) Soil depletion on prime agricultural lands

Source: Turner et al. (1990)

A4. **Cumulative problems** decrease the likelihood of regime formation.

Definition:

A **cumulative problem** is when the activity that causes the environmental problem is local in domain, but because widely replicated, in sum, constitutes a global environmental problem.

Indicator:

The cumulative meaning of global refers to the functioning of the system. Hence a cumulative problem is one in which the activity that causes environmental change is local in domain, but is widely replicated and thus in sum constitutes change in the whole human environment. This includes changes to the faces of the earth, such as landscape, or in forest, grasslands and wetlands. Furthermore, biogeochemical flows that remain below globally systemic scale in their movement are included. These are for instance sulphur and nitrogen oxides and water pollution (Turner et al. 1990). For more examples and comparison see figure below.

Two types of global environmental change

Table 1. Types of global environmental change.

Type	Characteristic	Examples
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Cumulative	Impact through worldwide distribution of change	(a) Groundwater pollution and depletion (b) Species depletion/genetic alteration (biodiversity)
	Impact through magnitude of change (share of global resource)	(a) Deforestation (b) Industrial toxic pollutants (c) Soil depletion on prime agricultural lands

Source: Turner et al. (1990)

A5. **Scientific uncertainty** decreases the likelihood of regime formation.

Definition:

Scientific uncertainty refers to having incomplete knowledge of the causes of the environmental problem, and its likely consequences upon the natural and human environment. In those cases constant research is needed in order to investigate scenarios and future projections of likely impacts.

Indicator:

Scientific uncertainty: A way of qualitatively expressing the presence of 'scientific uncertainty' is if wide-scale scientific reports have been conducted on the environmental problem before the international negotiation of the regime. This implies at the minimum some degree of certainty on the environmental issue, and of the level of uncertainty is known.

A6. In case of a **collaboration problem**, regime formation is less likely.

Definition:

A **collaboration problem** is a situation where all actors benefit from the regulation of an environmental problem even though not all of them are obliged to bear the same costs.

Indicator:

This project is only concerned with collaboration problems, thus all regime cases are of the collaborative type of problem.

B. Negotiation Process

B1. The higher the **negotiation costs**, the less likely is regime formation.

Definition:

Negotiation costs are the costs undertaken by the participating states in order to enable communication, and agreement on setting up a new regime. These can include diplomatic meeting costs, establishment of facilitator, and communication up until the moment the regime is formed.

Indicator:

In the International Relations literature, scholars traditionally and implicitly rely on soft proxies, for example a small number of participating actors is usually expected to have low negotiation costs (Lipson 2004). However, attempts have been made at constructing a methodology for measuring the actual negotiation costs post-regime formation (see Munoz, Trasher and Najam 2009), the concern in this context is pre-regime formation, and a soft proxy such as the number of participants/actors is used.

B2. If a problem is marked with great **asymmetry** of **powerful states' interests**, **differentiation of rules** increases likelihood of regime formation.

Definitions:

Asymmetry of Powerful states' interest refers to the situation where powerful states have a different view on the problem's importance, according to their own agenda. The ones severely affected are more interested in forming a regime to manage the impacts, whereas the rest are more reluctant.

Differentiation of rules refers to adopting different measures and targets according to specific contribution of the state actors to the problem. For instance, the industrialized states that are mainly responsible for climate change should be held more accountable than developing countries, which do not contribute as much to the problem even though they suffer most from the consequences.

Indicators:

Asymmetry of powerful states' interest:

In international relations, states are traditionally expected to act as a utility maximizing unit, meaning they have an interest in cooperation. In this context, this means that if the benefits exceed the costs, states have an interest in forming a regime (Hasenclever et al. 1997: 30-33). This presumptive argument has been further specified in a model for calculating states' environmental policy for various issues (Sprinz and Vaathoranta 1994). In a general manner asymmetry in the interest of powerful states will be reflected by whether the environmental issue is characterized by asymmetry in either the impacts or the actions needed per member country to solve the problem. Powerful states are those that because of size, population or economic capabilities, can practice structural leadership in the negotiations (Young 1991).

Differentiation of rules:

Differentiation of rules is used when explicitly stated in the treaty that different parties have different obligations or differentiated burden-sharing of the targets. An illustrative example is the categorization of Annex 1 and non-Annex countries with different burden sharing within the climate regime. Another example can be found in Article 3 (1) of the UNFCCC: "The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. Accordingly, the developed country Parties should take the lead in combating climate change and the adverse effects thereof" (UNFCCC, 1992 Art.3(1).

B3. If a problem is marked with great **asymmetry of interest between important states within the issue area**, **differentiation of rules** increases likelihood of regime formation.

Definitions:

Asymmetry of interest between important states within the issue area refers to the situation when important states have a different view on the problem's importance, according to their own agenda. The ones severely affected are more interested in forming a regime to manage the impacts, whereas the rest are more reluctant.

Differentiation of rules refers to adopting different measures and targets according to specific contribution of the state actors to the problem. For instance, the industrialized states that are mainly responsible for climate change should be held more accountable than developing countries, which do not contribute as much to the problem even though they suffer most from the consequences.

Indicators:

Asymmetry of interest between important states within the issue area:

In international relations, states are traditionally expected to act as a utility maximizing unit, meaning they have an interest in cooperation. In this context, this means that if the benefits exceed the costs, states have an interest in forming a regime (Hasenclever et al. 1997: 30-33). This presumptive argument has been further specified in a model for calculating states' environmental policy for various issues (Sprinz and Vaathoranta 1994). The states that are considered important within the issue area, are those that either have a central role in either causing the problem, or have a central role to play in solving it.

Differentiation of rules:

Differentiation of rules is used when explicitly stated in the treaty that different parties have different obligations or differentiated burden-sharing of the targets. An illustrative example is the categorization of Annex 1 and non-Annex countries with different burden sharing within the regime. Another example can be found in Article 3 (1) of the UNFCCC: "The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. Accordingly, the developed country Parties should take the lead in combating climate change and the adverse effects thereof" (UNFCCC, 1992 Art.3(1).

B4. In case of a **collaboration problem**, the more **side-payments** are made available, the more likely is regime formation.

Definitions:

A collaboration problem is a situation where all actors benefit from the regulation of an environmental problem even though not all of them are obliged to bear the same costs.

Side-payments are a form of incentives, such as transfer of money for being part of the regime, or payment for non-use of a resource.

Indicators:

Collaboration problem:

This project is only concerned with collaboration problems, thus all regime cases are of the collaborative type of problem.

Side-payments:

If the negotiation is concerned with discussions of technology transfer and/or capacity building it is assumed side-payments are available.

[B5. In case of **high transaction costs** and **scientific uncertainty**, an **initial framework treaty** followed by more precise agreements increases likelihood of regime formation.]

Although the rule might have influence, it is not included in this stage because of the difficulty of operationalisation to fit boundaries of the project possibility to collect sufficient data.

[B6. If the environmental problem is considered **urgent by a majority of actors**, an **initial informal agreement** increases likelihood of regime formation.]

Although the rule might have influence, it is not included in this stage because of the difficulty of operationalisation to fit boundaries of the project possibility to collect sufficient data.

[B7. In case of **cumulative cleavages**, regime formation is more likely if there are **positive or negative incentives.]**

Although the rule might have influence, it is not included in this stage because of the difficulty of operationalisation to fit boundaries of the project possibility to collect sufficient data.

[B8. In case of a **collaboration problem**, regime formation is more likely if there are **positive issue-linkages**.]

Although the rule might have influence, it is not included in this stage because of the difficulty of operationalisation to fit boundaries of the project possibility to collect sufficient data.

[B9. In case of **cumulative cleavages**, regime formation is less likely.]

Although the rule might have influence, it is not included in this stage because of the difficulty of operationalisation to fit boundaries of the project possibility to collect sufficient data.

C. Actors

C1. In case of a **systemic environmental problem**, non-support of one or more **important states within the issue area**, decreases likelihood of regime formation.

Definitions:

A **systemic problem** is when the activity that causes the environmental problem has a direct physical global impact, even though the activity in itself need not necessarily be of global scale.

Important states within the issue area have a stake in the cause of the problem and/or the solution of the problem.

Indicators:

Systemic problem:

The systemic meaning of global refers to the functioning of a system. According to this definition the activity need not be at global-scale, but the physical impacts of the activity need to be global in order to qualify as a globally systemic change. The problems of greenhouse gases and gases that deplete the stratospheric ozone layer are examples of systemic problems. Although the activity of emitting these gases is asymmetrically distributed in geographic terms over the globe, when released into the air, spreads in the whole atmosphere and thus have direct physical impact on a global level (Turner et al. 1990). For more examples and comparison see figure below.

Two types of global environmental change

Table 1. Types of global environmental change.

Type	Characteristic	Examples
Systemic	Direct impact on globally functioning system	(a) Industrial and land use emissions of 'greenhouse' gases (b) Industrial and consumer emissions of ozone-depleting gases (c) Land cover changes in albdeo
Cumulative	Impact through worldwide distribution of change	(a) Groundwater pollution and depletion (b) Species depletion/genetic alteration (biodiversity)
	Impact through magnitude of change (share of global resource)	(a) Deforestation (b) Industrial toxic pollutants (c) Soil depletion on prime agricultural lands

Source: Turner et al. (1990)

Important states within the issue area are those that contribute to the problem (e.g. those states responsible for the major part of pollution). Non-participation of one of them means that this important state is not part of the regime.

C2. In case of a **cumulative environmental problem**, the more of the **important states within the issue area** support a regime, the more likely is regime formation.

Definitions:

A **cumulative problem** is when the activity that causes the environmental problem is local in domain, but because widely replicated, in sum, constitutes a global environmental problem.

Important states within the issue area have a stake in the cause of the problem and/or the solution of the problem.

Indicators:

Cumulative problem:

The cumulative meaning of global refers to the functioning of the system. Hence a cumulative problem is one in which the activity that causes environmental change is local in domain, but is widely replicated and thus in sum constitutes change in the whole human environment. This includes changes to the faces of the earth, such as landscape, or in forest, grasslands and wetlands. Furthermore, biogeochemical flows that remain below globally systemic scale in their movement are included. These are for instance sulphur and nitrogen oxides and water pollution (Turner et al. 1990). For more examples and comparison see figure below.

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Source: Turner et al. (1990)

Important states within the issue area are those that contribute to the problem (e.g. those states responsible for the major part of pollution). The more of those states are parties to the regime, the more likely is its formation.

C3. Great **asymmetry** of **powerful states' interests** decreases likelihood of regime formation.

Definition:

Asymmetry of powerful states' interest refers to the situation where powerful states have a different view on the problem's importance, according to their own agenda. The ones severely affected are more interested in forming a regime to manage the impacts, whereas the rest are more reluctant.

Indicator:

Asymmetry of powerful states' interest:

In international relations, states are traditionally expected to act as a utility maximizing unit, meaning they have an interest in cooperation. In this context, this means that if the benefits exceed the costs, states have an interest in forming a regime (Hasenclever et al.1997: 30-33). This presumptive argument has been further specified in a model for calculating states' environmental policy for various issues (Sprinz and Vaathoranta 1994). In a general manner the asymmetry in interest of powerful states will be reflected by whether the environmental issue is characterized by asymmetry in either the impacts or the actions needed per member country to solve the problem. Powerful states are those that because of size, population or economic capabilities, can practice structural leadership in the negotiations (see Young 1991).

C4. Great **asymmetry of interest between important states within the issue area** decreases likelihood of regime formation.

Definition:

Asymmetry of interest between important states within the issue area refers to the situation when important states have a different view on the problem's importance, according to their own agenda. The ones severely affected are more interested in forming a regime to manage the impacts, whereas the rest are more reluctant.

Indicator:

Asymmetry of interest between important states within the issue area:

In international relations, states are traditionally expected to act as a utility maximizing unit, meaning they have an interest in cooperation. In this context, this means that if the benefits exceed the costs, states have an interest in forming a regime (Hasenclever et al. 1997: 30-33). This presumptive argument has been further specified in a model for calculating states' environmental policy for various issues (Sprinz and Vaathoranta 1994). The states that are considered important within the issue area, are those that either have a central role in either causing the problem, or have a central role to play in solving it.

C5. If almost all **powerful states** support regime formation, then regime formation is more likely.

Definition:

Powerful states are states that have the political and economic power to practice structural leadership, either encourage and/or impose regime formation.

Indicator:

Powerful states are those that because of size, population or economic capabilities, can practice structural leadership in the negotiations (see Young 1991), and can here be determined by using proxies of size and GDP.

C6. If almost all **important states within the issue area** support regime formation, then regime formation is more likely.

Definition:

Important states within the issue area have a stake in the cause of the problem and/or the solution of the problem.

Indicator:

Important states within the issue area are those that contribute to the problem (e.g. those states responsible for the major part of pollution). In most cases projections and calculations on the contribution of each party to the problem, would be conducted before the actual negotiation phase. Hence, an indicator could be that if a state contributes by more than a certain percentage to the problem, it is an important state within the issue area. By supporting the regime, means the state is pushing for its creation, and not only becomes a passive member.

C7. The **fewer economic sectors** are needed to regulate an environmentally harmful activity, the more likely is regime formation.

Definition:

Economic sectors are the individual industries that cause an environmental harmful activity. If a limited number of industries are affected by regulation, then it is easier to form an agreement.

Indicator:

Relative number of industries needed to regulate the activity. The United Nations Statistics Division has developed an 'International Standard Industrial Classification of All Economic Activities' that could be used to identify the number of individual industries involved in the regulation of an activity.

C8. If the **states** needed to regulate a harmful activity are **homogeneous,** then regime formation is more likely.

Definition:

Traditionally homogeneity has been assessed by economic, geographical, cultural and political backgrounds of the participant countries.

Indicator:

For global problems, an indicator would be the North-South dimension along the distinction between OECD/non-OECD countries.

[C9. If the environmental problem is considered **urgent** by **the majority of states**, then regime formation is more likely.]

Although the rule might have influence, it is not included in this stage because of the difficulty of operationalisation to fit boundaries of the project possibility to collect sufficient data.

[C10. If the **coalition of 'pushers'** is **more powerful** than the rest, regime formation is more likely.]

Although the rule might have influence, it is not included in this stage because of the difficulty of operationalisation to fit boundaries of the project possibility to collect sufficient data.

[C11. If the **coalition of 'laggards'** within a regime is **more powerful** than the rest, regime formation is less likely.]

Although the rule might have influence, it is not included in this stage because of the difficulty of operationalisation to fit boundaries of the project possibility to collect sufficient data.

D. Regime Environment

D1. The existence of a **preceding international agreement** dealing with the same or a similar problem enhances the likelihood of regime formation.

Definition:

A preceding agreement or policy refers to a certain pre-existing policies dealing with the same or similar issue(s), irrespective of whether it is still in force.

Indicator:

The definition might be sufficient as indicator. Either there is an official preceding agreement or there is not.

D2. **Consensual scientific information** by **scientific advisory bodies** increases the likelihood of regime formation.

Definition:

Consensual scientific information refers to assessments of the environmental problem at hand, its causes and effects, done by appointed groups of scientists. These assessments when taking place at the offset of the environmental problem can facilitate discussions on the establishment of the regime.

Scientific advisory bodies are appointed groups of scientists, who are expected to produce scientific assessments for the problem at hand. The groups are either already established panels, like for instance the Intergovernmental Panel on Climate Change, or ad-hoc groups set up for this purpose.

Indicator:

Consensual scientific information would mean that there are scientific reports conducted on the issue, conducted by an appointed group of scientists.

If a scientific advisory body or panel had an advisory status at the conference that led to the formation. If the negotiation intends to build on a prior framework agreement there might already be a scientific advisory body established, such as the Subsidiary Body for Scientific and Technological Advice (SBSTA) to the UNFCCC and CBA.

[D3. **Participation by stakeholders** in decision-making increases the likelihood of regime formation.]

Although the rule might have influence, it is not included in this stage because of the difficulty of operationalisation to fit boundaries of the project possibility to collect sufficient data.

II. Regime Implementation

E. Problem Structure

E1. In case of a **collaboration problem**, regime implementation is less likely.

Definition:

A **collaboration problem** is a situation where all actors benefit from the regulation of an environmental problem even though not all of them are obliged to bear the same costs.

Indicator:

This project is only concerned with collaboration problems, thus all regime cases are of the collaborative type of problem.

E2. The higher the **regulation costs**, the less likely is regime implementation.

Definition:

Regulation costs are the costs actors need to undertake in order to manage the environmental problem and to fulfil the rules decided upon in the regime.

Indicator:

The expected cost of action as calculated by secretariat working groups and scientific advisory bodies.

E3**. Systemic problems** increase the likelihood of regime implementation.

Definition:

A **systemic problem** is when the activity that causes the environmental problem has a direct physical global impact, even though the activity in itself need not necessarily be of global scale.

Indicator:

The systemic meaning of global refers to the functioning of a system. According to this definition the activity need not be at global-scale, but the physical impacts of the activity need to be global in order to qualify as a globally systemic change. The problems of greenhouse gases and gases that deplete the stratospheric ozone layer are examples of systemic problems. Although the activity of emitting these gases is asymmetrically distributed in geographic terms over the globe, when released into the air, they spread in the whole atmosphere and thus have direct physical impact on a global level (Turner et al. 1990). For more examples and comparison see figure below.

Two types of global environmental change

Table 1. Types of global environmental change.

Type	Characteristic	Examples
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Cumulative	Impact through worldwide distribution of change	(a) Groundwater pollution and depletion (b) Species depletion/genetic alteration (biodiversity)
	Impact through magnitude of change (share of global resource)	(a) Deforestation (b) Industrial toxic pollutants (c) Soil depletion on prime agricultural lands

Source: Turner et al. (1990)

E4. **Cumulative problems** decrease the likelihood of regime implementation.

Definition:

A **cumulative problem** is when the activity that causes the environmental problem is local in domain, but because widely replicated, in sum, constitutes a global environmental problem.

Indicator:

The cumulative meaning of global refers to the functioning of the system. Hence a cumulative problem is one in which the activity that causes environmental change is local in domain, but is widely replicated and thus in sum constitutes change in the whole human environment. This includes changes to the faces of the earth, such as landscape, or in forest, grasslands and wetlands. Furthermore, biogeochemical flows that remain below globally systemic scale in their movement are included. These are for instance sulphur and nitrogen oxides and water pollution (Turner et al. 1990). For more examples and comparison see figure below.

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Source: Turner et al. (1990)

F. Actors

F1. **Participation of high-level government** representation in COPs increases likelihood of regime implementation.

Definition:

High-level government officials are ministers, prime ministers and other diplomats, who when representing the state in the regime, give additional prestige and facilitate the implementation of the regime.

Indicator:

List of participants at the official meetings and conference of the parties (COPs).

F2. If almost all **powerful states** participate in a regime, then regime implementation is more likely.

Definition:

Powerful states are states that have the political and economic power to practice structural leadership, either encourage and/or impose regime implementation.

Indicator:

Powerful states are those that can practice structural leadership in the negotiations (see Young 1991), and can here be determined by using proxies of and proxies of size and GDP.

F3. If almost all **important states within the issue area** participate in a regime, then regime implementation is more likely.

Definition:

Important states within the issue area have a stake in the cause of the problem and/or the solution of the problem.

Indicator:

Important states within the issue area are those that contribute to the problem (e.g. those states responsible for the major part of pollution). In most cases projections and calculations on the contribution of each party to the problem, would be conducted both before the actual negotiation phase and during monitoring on a post-regime creation phase. Hence, a sufficient indicator is that if a state is contributing to the problem by a relatively high percentage, it is an important state within the issue area.

F4. The fewer **economic sectors** are needed to regulate an environmentally harmful activity, the more likely is regime implementation.

Definition:

Economic sectors are the individual industries that cause an environmental harmful activity. If a limited number of industries are affected by regulation, then it is easier to implement an agreement.

Indicator:

Relative number of industries needed to regulate the activity.

F5. In case of a **systemic environmental problem**, non-participation of one or more **important states within the issue area**, decreases regime implementation.

Definitions:

A **systemic problem** is when the activity that causes the environmental problem has a direct physical global impact, even though the activity in itself need not necessarily be of global scale.

Important states within the issue area have a stake in the cause of the problem and/or the solution of the problem.

Indicators:

Systemic problem:

The systemic meaning of global refers to the functioning of a system. According to this definition the activity need not be at global-scale, but the physical impacts of the activity need to be global in order to qualify as a globally systemic change. The problems of greenhouse gases and gases that deplete the stratospheric ozone layer are examples of systemic problems. Although the activity of emitting these gases is asymmetrically distributed in geographic terms over the globe, when released into the air, spreads in the whole atmosphere and thus have direct physical impact on a global level (Turner et al. 1990). For more examples and comparison see figure below.

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Source: Turner et al. (1990)

Important states within the issue area:

Important states are those that contribute to the problem (e.g. those states responsible for the major part of pollution). In most cases projections and calculations on the contribution of each party to the problem, would be conducted both before the actual negotiation phase and during monitoring on a post-regime creation phase. Hence, a sufficient indicator is that if a state is contributing to the problem by a relatively high, it is an important state within the issue area.

F6. In case of a **cumulative environmental problem**, the more of the **important states within the issue area** participate in the regime, the more likely is regime implementation.

Definitions:

A **cumulative problem** is when the activity that causes the environmental problem is local in domain, but because widely replicated, in sum, constitutes a global environmental problem.

Important states within the issue area have a stake in the cause of the problem and/or the solution of the problem.

Indicators:

Cumulative problem:

The cumulative meaning of global refers to the functioning of the system. Hence a cumulative problem is one in which the activity that causes environmental change is local in domain, but is widely replicated and thus in sum constitutes change in the whole human environment. This includes changes to the faces of the earth, such as landscape, or in forest, grasslands and wetlands. Furthermore, biogeochemical flows that remain below globally systemic scale in their movement are included. These are for instance sulphur and nitrogen oxides and water pollution (Turner et al. 1990). For more examples and comparison see figure below.

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[F7. **Outvoting** of **important states within the issue area** decreases regime implementation.]

Although the rule might have influence, it is not included in this stage because of the difficulty of operationalisation to fit boundaries of the project possibility to collect sufficient data.

F8. Great **asymmetry of powerful states' interests** decreases likelihood of regime implementation.

Definition:

Asymmetry of powerful states' interest refers to the situation where powerful states have a different view on the problem's importance, according to their own agenda. The ones severely affected are more interested in forming a regime to manage the impacts, whereas the rest are more reluctant.

Indicator:

Asymmetry of powerful states' interest:

In international relations, states are traditionally expected to act as a utility maximizing unit, meaning they have an interest in cooperation. In this context, this means that if the benefits exceed the costs, states have an interest in forming a regime (Hasenclever et al. 1997: 30-33). This presumptive argument has been further specified in a model for calculating states' environmental policy for various issues (Sprinz and Vaathoranta 1994). In a general manner the asymmetry in interest of powerful states will be reflected by whether the environmental issue is characterized by asymmetry in either the impacts or the actions needed per member country to solve the problem. Powerful states are those that because of size, population or economic capabilities, can practice structural leadership in the negotiations (see Young 1991).

F9. Great **asymmetry of interest between important states within the issue area** decreases likelihood of regime implementation.

Definition:

Asymmetry of interest between important states within the issue area refers to the situation when important states have a different view on the problem's importance, according to their own agenda. The ones severely affected are more interested in forming a regime to manage the impacts, whereas the rest are more reluctant.

Indicator:

Asymmetry of interest between important states within the issue area:

In international relations, states are traditionally expected to act as a utility maximizing unit, meaning they have an interest in cooperation. In this context, this means that if the benefits exceed the costs, states have an interest in forming a regime (Hasenclever et al. 1997: 30-33). This presumptive argument has been further specified in a model for calculating states' environmental policy for various issues (Sprinz and Vaathoranta 1994). The states that are considered important within the issue area, are those that either have a central role in either causing the problem, or have a central role to play in solving it.

G. Regime Design

G1. **Regime mechanisms that increase scientific knowledge generation**, synthesis and dissemination are likely to increase regime implementation.

Definition:

Regime mechanisms that **increase scientific knowledge** generation can be scientific advisory bodies, or simply Working Groups established within the regime.

Indicator:

If such mechanisms are included in the regime, it will be stated in the institutional structure.

G2. If a problem is marked with great **asymmetry** of **powerful states' interests**, **differentiation of rules** increases likelihood of regime implementation.

Definitions:

Asymmetry of Powerful states' interest refers to the situation where powerful states have a different view on the problem's importance, according to their own agenda. The ones severely affected are more interested in withholding a regime to manage the impacts, whereas the rest are more reluctant.

Differentiation of rules refers to adopting different measures and targets according to specific contribution of the state actors to the problem. For instance, the industrialized states that are mainly responsible for climate change should be held more accountable than developing countries, which do not contribute as much to the problem even though they suffer most from the consequences.

Indicators:

Asymmetry of powerful states' interest:

In international relations, states are traditionally expected to act as a utility maximizing unit, meaning they have an interest in cooperation. In this context, this means that if the benefits exceed the costs, states have an interest in forming a regime (Hasenclever et al. 1997: 30-33). This presumptive argument has been further specified in a model for calculating states' environmental policy for various issues (Sprinz and Vaathoranta 1994). In a general manner the interest of powerful states will be reflected by if the environmental issue is characterized by asymmetry in either the impacts or the actions needed per member country to solve the problem. Powerful states are those that because of size, population or economic capabilities, can practice structural leadership in the negotiations (Young 1991).

Differentiation of rules:

Differentiation of rules is used when explicitly stated in the treaty that different parties have different obligations or differentiated burden-sharing of the targets. An illustrative example is the categorization of Annex 1 and non-Annex countries with different burden sharing within the regime. Another example can be found in Article 3 (1) of the UNFCCC: "The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. Accordingly, the developed country Parties should take the lead in combating climate change and the adverse effects thereof" (UNFCCC, 1992 Art.3(1).

G3. If a problem is marked with great **asymmetry of interest between important states within the issue area**, **differentiation of rules** increases likelihood of regime implementation.

Definitions:

Asymmetry of interest between important states within the issue area refers to the situation when important states have a different view on the problem's importance, according to their own agenda. The ones severely affected are more interested in a regime to manage the impacts, whereas the rest are more reluctant.

Differentiation of rules refers to adopting different measures and targets according to specific contribution of the state actors to the problem. For instance, the industrialized states that are mainly responsible for climate change should be held more accountable than developing countries, which do not contribute as much to the problem even though they suffer most from the consequences.

Indicators:

Asymmetry of interest between important states within the issue area:

In international relations, states are traditionally expected to act as a utility maximizing unit, meaning they have an interest in cooperation. In this context, this means that if the benefits exceed the costs, states have an interest in forming a regime (Hasenclever et al. 1997: 30-33). This presumptive argument has been further specified in a model for calculating states' environmental policy for various issues (Sprinz and Vaathoranta 1994). The states that are considered important within the issue area, are those that either have a central role in either causing the problem, or have a central role to play in solving it.

Differentiation of rules:

Differentiation of rules is used when explicitly stated in the treaty that different parties have different obligations or differentiated burden-sharing of the targets. An illustrative example is the categorization of Annex 1 and non-Annex countries with different burden sharing within the regime. Another example can be found in Article 3 (1) of the UNFCCC: "The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. Accordingly, the developed country Parties should take the lead in combating climate change and the adverse effects thereof" (UNFCCC, 1992 Art.3(1).

G4. In case of a **collaboration problem**, regime implementation is more likely if there is a **strong compliance mechanism**.

Definitions:

A **collaboration problem** is a situation where all actors benefit from the regulation of an environmental problem even though not all of them are obliged to bear the same costs.

A **strong compliance mechanism** is a mechanism that can impose sanctions on the parties that do not comply with the rules of the regime.

Indicators:

Collaboration problem:

This project is only concerned with collaboration problems, thus all regime cases are of the collaborative type of problem.

Compliance mechanism:

The role and status of the compliance mechanism as stated in the treaty.

G5. Regime implementation is more likely if there are **side-payments**.

Definition:

Side-payments are a form of incentives, such as transfer of money for being part of the regime, or payment for non-use of a resource.

Indicator:

If the regime includes rules for technology transfer and/or capacity building it is assumed side-payments are available.

G6. In case of a **coordination problem**, regime implementation is less likely without a strong **information and communication mechanism**.

Definitions:

A coordination problem is a situation where all actors' interests converge, and it is only a matter of organizing the flow of information and communication in order to solve it, as for instance the coordination of marine or air traffic.

An information and communication mechanism is a mechanism within the regime, which coordinates the exchange of information among the parties in order to manage the problem at hand.

Indicators:

Coordination problem: None of our cases are coordination problems**.**

Information and communication mechanism: If there is a mechanism for information and communication, it will be a part of the institutional structure of the regime.

G7. The more **precise** the **rules** of a regime are, the more likely is regime implementation.

Definition:

High precision rules require only narrow interpretation (e.g. targets) whereas low precision rules refer to setting of standards.

Indicator:

Research conducted on the concept of legalization trying to combine international with international relations conceptualize precision of rule as the following.

TABLE 3. *Indicators of precision*

High
Determinate rules: only narrow issues of interpretation
Substantial but limited issues of interpretation
Broad areas of discretion
"Standards": only meaningful with reference to specific situations
Impossible to determine whether conduct complies
Low

Source: Abbott et al. (2000)

In our project very precise rules are those that include specific targets and timetables, e.g. Protocols. Intermediate rules are those with clear but broad objectives, e.g. framework conventions. The lowest form of precision is when the agreement only includes principles (Abbott et al. 2000).

G8. **Legally binding rules** increase the likelihood of regime implementation.

Definition:

Legally binding rules are explicit conditions of obligation, whereas non-legally binding rules can have the form of recommendations and guidelines.

Indicator:

A treaty includes rules with explicit intent to be legally bound.

Research conducted on the concept of legalization trying to combine international law with international relations, uses the concept like this:

TABLE 2. *Indicators of obligation*

High
Unconditional obligation; language and other indicia of intent to be legally bound
Political treaty: implicit conditions on obligation
National reservations on specific obligations; contingent obligations and escape clauses
Hortatory obligations
Norms adopted without law-making authority; recommendations and guidelines
Explicit negation of intent to be legally bound
Low

Source: Abbott et al. (2000)

In our project legally binding rules include Treaties, Conventions, Protocols and all their subsequent amendments. Non-legally binding rules are Declarations, Recommendations and Guidelines (Abbott et al. 2000).

G9. **Differentiated rules** increase the likelihood of regime implementation.

Definition:

Differentiation of rules refers to adopting different measures and targets according to specific contribution of the state actors to the problem. For instance, the industrialized states that are mainly responsible for climate change should be held more accountable than developing countries, which do not contribute as much to the problem even though they suffer most from the consequences.

Indicator:

Differentiation of rules is used when explicitly stated in the treaty that different parties have different obligations or differentiated burden-sharing of the targets. An illustrative example is the categorization of Annex 1 and non-Annex countries with different burden sharing within the regime. Another example can be found in Article 3 (1) of the UNFCCC: "The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. Accordingly, the developed country Parties should take the lead in combating climate change and the adverse effects thereof" (UNFCCC, 1992 Art.3(1).

G10. The existence of a **strong autonomous secretariat** increases the likelihood of regime implementation.

Definition:

A strong secretariat possesses agency, which is the ability to act, develops autonomously policy, and has adequate financial resources and support for this reason.

Indicator:

We assume that a secretariat with high influence is the same as a strong secretariat. See Biermann and Siebenhüner (eds.), (2009a).

G11. **Mechanisms for regular reporting and implementation review** increase the likelihood of regime implementation.

Definition:

Mechanisms for regular reporting and implementation are part of the institutional structure of the secretariat, which require the members to report their activities concerning the regime's implementation. They can also be seen as a form of weak compliance mechanism.

Indicator:

Either there is a mechanism or not. If applied, it would be stated in the institutional structure of the regime.

[G12. **Voting systems based on consensus or unanimity** lead to weaker decisions in regime implementation, which decreases regime implementation.]

Although the rule might have influence, it is not included in this stage because of the difficulty of operationalisation to fit boundaries of the project possibility to collect sufficient data.

[G13. Regimes with **broad issue coverage** are more likely to be implemented.]

Although the rule might have influence, it is not included in this stage because of the difficulty of operationalisation to fit boundaries of the project possibility to collect sufficient data.

[G14. Regime **mechanisms** that increase **public awareness** are likely to increase regime implementation.]

Although the rule might have influence, it is not included in this stage because of the difficulty of operationalisation to fit boundaries of the project possibility to collect sufficient data.

[G15. In case of a **collaboration problem**, regime implementation is more likely if there **are positive side-payments**.]

Although the rule might have influence, it is not included in this stage because of the difficulty of operationalisation to fit boundaries of the project possibility to collect sufficient data.

[G16. **Sanction mechanisms** within a regime increase likelihood of regime implementation.]

Although the rule might have influence, it is not included in this stage because of the difficulty of operationalisation to fit boundaries of the project possibility to collect sufficient data.

[G17. An **autonomous standing decision-body** increases the likelihood of regime implementation.]

Although the rule might have influence, it is not included in this stage because of the difficulty of operationalisation to fit boundaries of the project possibility to collect sufficient data.

[G18. An **ad-hoc decision-body** or a **regular meeting of the Conference of the Parties** decreases the likelihood of regime implementation.]

Although the rule might have influence, it is not included in this stage because of the difficulty of operationalisation to fit boundaries of the project possibility to collect sufficient data.

H. Regime Environment

H1. The embedding of a regime in a **larger institutional framework** increases the likelihood of regime implementation.

Definition:

A **larger institutional framework** can be an overarching institution (such as WTO or IMO), which will help in implementing the regime.

Indicator:

The embeddedness would be laid down in the institutional structure of the regime.

H2. **Negative interplay** with other regimes decreases regime implementation.

Definition:

Interplay refers to the process of interaction between governance systems and more specifically when international regimes influence each other in ways that are relevant for their development and effectiveness (Oberthür and Gehring 2006). Negative interplay is when obligations or objectives in one regime conflicts with the obligations or objectives of other regimes.

Indicator:

In formal sense interplay between regimes can be narrowed down to only include the actual treaties and agreements of the regimes. This would then be an international law approach to institutional interplay. An indicator for the interplay with other regimes is when other environmental issue-areas, or the treaties from other regimes, are mentioned in the agreements of one regime. Negative interplay, on the level of interaction through commitment, occurs when incentives in one regime have negative impact on the objectives of other regimes (Gehring and Oberthür 2008: 203-205).

[H3. **Positive interactions** with other regimes increase regime implementation.]

Although the rule might have influence, it is not included in this stage because of the difficulty of operationalisation to fit boundaries of the project possibility to collect sufficient data.

[H4. **Participation by stakeholders** in decision-making increases the likelihood of regime implementation.]

Although the rule might have influence, it is not included in this stage because of the difficulty of operationalisation to fit boundaries of the project possibility to collect sufficient data.

4 Conclusions

In this report, we have introduced the theoretical and conceptual background to our attempt to model the effectiveness of international environmental regimes. As outlined in more detail above, the more quantitatively oriented modelling and scenarios community is increasingly becoming interested in international regimes, which play a central role in global environmental governance. As a result of the increasing interdependence and interconnectedness in a finite world, there is an increase in collective action problems related to international public goods, commons and shared natural resources. As a consequence, more than 200 multilateral treaties regulate environmental problems ranging from the overexploitation of natural resources to problems of global environmental change, such as climate change or biodiversity loss.

A number of approaches exist toward understanding and measuring the effectiveness of institutions in steering society and the international system at large towards sustainability in the fields of International Relations and global environmental governance research (Biermann et al. 2007). Within this research field, the literature on international regimes provides numerous hypotheses regarding the factors that increase or diminish the likelihood of regime formation and implementation, and thereby potential problem-solving effectiveness. As detailed in this report, the ModelGIGS project has synthesized this research into a number of concrete rules that describe the likelihood of regime formation and implementation with a view towards integrating these findings into more formalized methodologies such as modelling, computer simulation and scenario development (de Vos et al. 2010).

In addition to this attempt to formalize existing knowledge of institutional effectiveness in global environmental politics, this report also suggest a conceptual framework that can be used to assess, in a qualitative way, the potential problem-solving capacity of international environmental regimes (both the likelihood of actually agreeing on an international regime as well as successfully implementing agreed-upon commitments). The suggested conceptual model therefore also allows assessing hypothetical situations of international cooperation on any given issue-area (for an application of the ModelGIGS conceptual framework to the issue area of biodiversity governance, see Dellas and Pattberg 2011).

In sum, this report provides the necessary background information to understand our attempt to build a formal model of international regime effectiveness in the area of environmental politics. But it also suggests a concrete conceptual model for more qualitative-oriented research on environmental governance and institutions.

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Annex A Full List of Rules

I. Regime Formation

A. Problem Structure

A1. The higher the regulation costs, the less likely is regime formation.

A2. High public concern for the problem increases likelihood of regime formation.

A3. Systemic problems increase the likelihood of regime formation.

A4. Cumulative problems decrease the likelihood of regime formation.

A5. Scientific uncertainty decreases the likelihood of regime formation.

A6. In case of a collaboration problem, regime formation is less likely.

B. Negotiation Process

B1. The higher the negotiation costs, the less likely is regime formation.

B2. If a problem is marked with great asymmetry of powerful states' interests, differentiation of rules increases likelihood of regime formation.

B3. If a problem is marked with great asymmetry of interest between important states within the issue area, differentiation of rules increases likelihood of regime formation.

B4. In case of a collaboration problem, the more side-payments are made available, the more likely is regime formation.

[B5. In case of high transaction costs and scientific uncertainty, an initial framework treaty followed by more precise agreements increases likelihood of regime formation.]

[B6. If the environmental problem is considered urgent by a majority of actors, an initial informal agreement increases likelihood of regime formation.]

[B7. In case of cumulative cleavages, regime formation is more likely if there are positive or negative incentives.]

[B8. In case of a collaboration problem, regime formation is more likely if there are positive issue-linkages.]

[B9. In case of cumulative cleavages, regime formation is less likely.]

C. Actors

C1. In case of a systemic environmental problem, non-support of one or more important states within the issue area, decreases likelihood of regime formation.

C2. In case of a cumulative environmental problem, the more of the important states within the issue area support a regime, the more likely is regime formation.

C3. Great asymmetry of powerful states' interests decreases likelihood of regime formation.

C4. Great asymmetry of interest between important states within the issue area decreases likelihood of regime formation.

C5. If almost all powerful states support regime formation, then regime formation is more likely.

C6. If almost all important states within the issue area support regime formation, then regime formation is more likely.

C7. The fewer economic sectors are needed to regulate an environmentally harmful activity, the more likely is regime formation.

C8. If the states needed to regulate a harmful activity are homogeneous, then regime formation is more likely.

[C9. If the environmental problem is considered urgent by the majority of states, then regime formation is more likely.]

[C10. If the coalition of 'pushers' is more powerful than the rest, regime formation is more likely.]

[C11. If the coalition of 'laggards' within a regime is more powerful than the rest, regime formation is less likely.]

D. Regime Environment

D1. The existence of a preceding international agreement dealing with the same or a similar problem enhances the likelihood of regime formation.

D2. Consensual scientific information by scientific advisory bodies increases the likelihood of regime formation.

[D3. Participation by stakeholders in decision-making increases the likelihood of regime formation.]

II. Regime Implementation

E. Problem Structure

E1. In case of a collaboration problem, regime implementation is less likely.

E2. The higher the regulation costs, the less likely is regime implementation.

E3. Systemic problems increase the likelihood of regime implementation.

E4. Cumulative problems decrease the likelihood of regime implementation.

F. Actors

F1. Participation of high-level government representation in COPs increases likelihood of regime implementation.

F2. If almost all powerful states participate in a regime, then regime implementation is more likely.

F3. If almost all important states within the issue area participate in a regime, then regime implementation is more likely.

F4. The fewer economic sectors are needed to regulate an environmentally harmful activity, the more likely is regime implementation.

F5. In case of a systemic environmental problem, non-participation of one or more important states within the issue area, decreases regime implementation.

F6. In case of a cumulative environmental problem, the more of the important states within the issue area participate in the regime, the more likely is regime implementation.

[F7. Outvoting of important states within the issue area decreases regime implementation.]

F8: Great asymmetry of interest between powerful states decreases likelihood of regime implementation.

F9: Great asymmetry of interest between important states within the issue area decreases likelihood of regime implementation.

G. Regime Design

G1. Regime mechanisms that increase scientific knowledge generation, synthesis and dissemination are likely to increase regime implementation.

G2. If a problem is marked with great asymmetry of powerful states' interests, differentiation of rules increases likelihood of regime implementation.

G3. If a problem is marked with great asymmetry of interest between important states within the issue area, differentiation of rules increases likelihood of regime implementation.

G4. In case of a collaboration problem, regime implementation is more likely if there is a strong compliance mechanism.

G5. Regime implementation is more likely if there are side-payments.

G6. In case of a coordination problem, regime implementation is less likely without a strong information and communication mechanism.

G7. The more precise the rules of a regime are, the more likely is regime implementation.

G8. Legally binding rules increase the likelihood of regime implementation.

G9. Differentiated rules increase the likelihood of regime implementation.

G10. The existence of a strong autonomous secretariat increases the likelihood of regime implementation.

G11. Mechanisms for regular reporting and implementation review increase the likelihood of regime implementation.

[G12. Voting systems based on consensus or unanimity lead to weaker decisions in regime implementation, which decreases regime implementation.]

[G13. Regimes with broad issue coverage are more likely to be implemented.]

[G14. Regime mechanisms that increase public awareness are likely to increase regime implementation.]

[G15 In case of a collaboration problem, regime implementation is more likely if there are positive side-payments.]

[G16. Sanction mechanisms within a regime increase likelihood of regime implementation.]

[G17. An autonomous standing decision-body increases the likelihood of regime implementation.]

[G18. An ad-hoc decision-body or a regular meeting of the Conference of the Parties decreases the likelihood of regime implementation.]

H. Regime Environment

H1. The embedding of a regime in a larger institutional framework increases the likelihood of regime implementation.

H2. Negative interplay with other regimes decreases regime implementation.

[H3. Positive interactions with other regimes increase regime implementation.]

[H4. Participation by stakeholders in decision-making increases the likelihood of regime implementation.]

Annex B Glossary of Terms

Accountability: refers to a relationship between principal and agent, where individuals, states and other actors can demand that the agent reports their activities, and can reward or punish the agent accordingly (for example by exclusion, naming and shaming, legal action or cutting financial support).

Asymmetry of interest: this refers to a situation where (important) actors have diverging views regarding the significance of a problem, its implications and how to address it. This is because they are impacted by its negative consequences to different extents.

Autonomous standing decision-body: a formal, institutionalized and independent forum where representatives within a regime make decisions.

Binding rules: these are explicit conditions of obligation. Conversely, rules that are not legally binding can take the form of recommendations and guidelines.

Collaboration problem: this is a situation where all actors benefit from the regulation of an environmental problem, even though not all of them are obliged to bear the same costs.

Cleavages: these are divisions in the interests of negotiating parties of a regime. When negotiating parties align into rigid interest coalitions that agree on most issues, we refer to the situation as → **cumulative cleavages.** Where multiple overlaps in the interests of negotiating parties exist, we refer to this as → **crosscutting cleavages.**

Collective action problem: an issue where failure by actors to cooperate impacts the overall effectiveness of problem-solving attempts. However, incentives to not cooperate may be high for some actors.

Compliance: is a situation where the behaviour of members to a regime fully conforms to its rules.

Compliance mechanism: a tool used to enforce compliance with a regime, for example by threatening to impose sanctions on parties that do not conform to the rules of a regime.

C**onsensus rule:** this is a decision-making procedure where not all eligible parties have to explicitly agree with a measure, as is the case with unanimity. However, no party can disagree so strongly that it is willing to oppose the measure's adoption publicly and formally.

Coordination problem: this is a situation where all actors' interests converge, and it is only a matter of organizing the flow of information and communication in order to solve a problem.

Cross-cutting cleavages: cleavages are cross-cutting when actors do not find that their interests align with one groups of actors on all issues, but rather that they agree with one groups on one issue, but ally with another group on other issues. In such a situation, there is room for bargaining, compromises and making deals

Cumulative cleavages: Cleavages are cumulative when during the negotiations, rigid coalitions form among groups of actors, which have few overlapping interests. In this situation, negotiations are difficult.

C**umulative problem:** this exists when the activities that cause an environmental problem are local, but so widespread that they nonetheless constitute a global problem.

Decision-making/Decision rules: these procedures specify the conditions that must be met for the decisions reached within the context of an international regime to be accepted as legitimate. Typical examples are simple or other types of majority rule, unanimity or consensus.

Differentiation of rules: this refers to the adoption of different measures and targets for different actors, depending on their specific contribution to an environmental problem.

Effectiveness: the success of a regime or institution in producing results. Effectiveness can be achieved in relation to various issues, such as inducing behaviour change, meeting the regime's goals, solving an environmental problem, compliance by regime participants or implementation of the regime's rules.

Global Environmental Assessments: these are large-scale international scientific assessments intended to contribute to the scientific knowledge and consensus regarding an environmental concern.

Global (environmental) governance: politics that transgresses national borders, and is characterized in particular by the participation of non-state actors, the emergence of new governance institutions and mechanisms, and the fact that it crosses multiple governance levels and spheres.

High-level government representation: this includes involvement by ministers, prime ministers and other diplomats. When these high-ranking officials represent a state during regime negotiations, this give additional prestige and facilitate the implementation of the regime.

Homogeneity of actors: actors are homogenous when they have similar economic, geographical, cultural and political backgrounds, e.g. OECD/non-OECD countries. Regime formation is more likely among homogenous actors, as they may have similar preferences regarding the agreement in question.

Important states within the issue area: some states have a particular stake in the cause of the problem and/or its solution, and at the same time also possess the political and economic power to encourage or deter regime formation.

Informal instrumental leadership: refers to guidance by particular actors during the regime negotiation stage. It can be exercised either by officers of intergovernmental organizations, national delegates and chairs of conferences or working groups, or by formal or informal transnational networks.

Information and communication mechanism: such tools are important to coordinate the exchange of information among the parties regarding the problem at hand.

International institutions: these can be defined as "a cluster of rights, rules, and decision-making procedures that gives rise to a social practice, assigns roles to participants in the practice, and guides interactions among occupants in these roles" (Young et al. 2008: xxii).

International organization: in difference to regimes, which tend to be issue-specific, the mandates of organizations can be broader. Furthermore, they may be quite institutionalized, with "personnel, offices, equipment, a budget, and, often, legal personality" (Young et al. 2008: xxii).

International regime: an international regime is a set of "implicit or explicit principles, norms, rules, and decision-making procedures around which actors' expectations converge in a given area of international relations" (Krasner 1983: 2). In difference to international organizations, they tend to be issue-specific and do not have the capacity to act as a unified actor. Both international organizations and regimes are sub-categories of international institutions.

Institutional diagnostics: the process of identifying what the relevant contextual variables affecting the governance of an environmental problem are, as well as the most suitable regime design to address this problem.

Institutional Interplay: this refers to a process of interaction between regimes, international institutions, or different levels of governance in ways that influence their development and effectiveness.

Irreversibility: this concept refers to a situation where failure to take action on an environmental problem may lead to severe losses, for instance the depletion of fish stocks or extinction of endangered species.

Larger institutional framework: this can be an overarching institution (such as WTO or IMO), which will help in implementing the regime.

Legitimacy: a rule or institution possesses legitimacy either if the norms and rules it embodies are perceived to have moral validity, and/or if the procedures according to which these rules are agreed on are widely accepted.

Monitoring/Verification Mechanism: these are tools used to evaluate to what extent regime members comply with the rules set out by a regime.

Negotiation costs: these are the time and resources invested into negotiation procedures during the initial stages of regime formation.

Negotiation process: the discussions and consultations that are held between different actors with the intention of concluding an international environmental agreement. Issues such as the number and type of actors involved influence this process, their interests, and the type of problem they are discussing.

Non-regime: an environmental issue on which governments have thus far not made any policy agreements, or where attempts at cooperation have failed. Dimitrov (2003) argued for a greater focus on 'non-regimes', as any attempt to understand the conditions of successful regime formation and implementation needs to also understand under which conditions cooperation fails.

Participation: participation of affected stakeholders in the negotiation and implementation of a regime or institution is widely perceived as contributing to the availability of necessary information on the feasibility of a regime, increasing the effectiveness of its implementation, and contributing to democratic control by scrutinizing the activities of actors addressed by a regime.

Positive incentives: these encourage reluctant states to participate in an agreement. In particular, where non-compliance is the result of lacking capacity to do so, positive incentives in the form of financial assistance, transfer of technological expertise, or other bilateral assistance can increase compliance.

Powerful states: these are states that have the political and economic power to either encourage and/or impose regime formation.

Problem structure: this refers to the specific attributes of an environmental problem, which may influence to what extent a regime is deemed feasible as well as what type of rules and regulations are suitable to address it.

Programmatic activities: refers to organized efforts of international regimes which aim at improving their operation, for example through scientific assessment and monitoring, research, systems of implementation review, etc. These activities are often carried out by specific bodies or components/programs within a regime.

Qualified majority rule: this decision-making procedure requires agreement on a decision of any fraction beyond one half, such as 2/3 or 3/4 of eligible participants.

Preceding international agreement: this refers to pre-existing policies addressing the same issues as a new regime, irrespective of whether the policy is still in force.

Regime design: the components and characteristics that characterize a particular regime. Regime design can involve issues such as the rules and regulations governing decision-making rules, the type of obligations, the role of the secretariat, and monitoring and reporting requirements.

Regime environment: this is the wider context influencing a regime during its negotiation and implementation, including other institutions, organizations and norms.

Regime formation: this is the stage where a new set of rules and regulations governing a particular problem is created.

Regime implementation: during this stage, the participants or addressees of a regime apply and adapt to the rules specified in a regime, and behavioural change takes place.

Regime secretariat: this is an autonomous body, which has adequate financial resources and develops policies.

Regulation costs: are the costs actors incur while managing an environmental problem and complying with the rules of a regime.

Reporting mechanisms: these are requirements for regime members to provide information on their activities contributing to a regime's implementation.

Sanctions: these are restrictions which are applied in the case of violation of an agreements' provisions, such as trade restrictions or the withdrawal of the privileges of membership to the agreement.

Scientific advisory body: a regime can appoint a group of scientists as an advisory body, which is expected to produce scientific assessments of the problem at hand.

Scientific uncertainty refers to having incomplete knowledge of the causes of the environmental problem, and its likely consequences upon the natural and human environment. In those cases constant research is needed in order to investigate scenarios and future projections of likely impacts.

Secretariat → see Regime Secretariat

Side-payments→ see Positive incentives.

Simple majority rule: this requires the consent of 50 percent plus one of those eligible to participate in decision-making to agree for a decision to be legitimate and authoritative.

Stakeholder: an actor with an interest in the issue under consideration, for example because their livelihoods or economic interests are affected by it. In this report, 'stakeholder' is usually used to refer to non-state actors (business and civil society).

Systemic problem: this is when the activity that causes the environmental problem has a direct physical global impact, even though the activity in itself need not necessarily be of global scale.

Systems for Implementation Review (SIRs): these are rules and procedures governing how parties to international agreements exchange data, monitor activities, assess adequacy of commitments and handle poor implementation.

Transparency: this refers to the availability of information to actors within and outside a regime or institution that allows them to assess the decisions and actions taken by actors within the regime.

Unanimity rule: requires all of the participants to explicitly agree for a decision to be legitimate and authoritative.